The Kinematic Specification of Simulated Dyadic Social Interactions Using Point-Light Displays

A thesis submitted in partial

fulfilment of the requirements for the

Degree of

Master of Arts in Psychology

at the

University of Canterbury

by

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1997

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Abstract

This paper provided a background for an ecological approach to psychological inquiry and examined the usefulness of point-light displays as a technique for applying such an approach to the study of dyadic social events. An experiment was conducted testing the accuracy of identification of three simulated dyadic events between participants viewing a full-visual and a kinematic only version of events. Results showed participants exposed to kinematic only optical information identified two of the three simulated dyadic events as well as those provided a full-view version of events. However, for a more gesturally neutral event, perceivers made more accurate identifications in the full-visual condition. This finding suggests that the information necessary for participants to make accurate identifications of this dyadic event was either not available, not attended to, or inadequate in the point-light displays. It was suggested that point-light displays were useful in the examination of dyadic social events but some constraints on their usage appeared to be necessary. Results between free-verbal and forced-choice response conditions showed that participants made more accurate identifications in the forced-choice condition, suggesting that adaptive modification of perception (attunement) increased accuracy. Contrary to expectations, no support was found for the theory that perceptual learning would increase the ability of participants to abstract and differentiate progressively finer levels of invariant structure through experience, and no differences were found between males and females.

It was suggested that information for the assessment of dyadic social events with high levels of gestural animation (a) is available to participants in the dynamics of movement, (b) resides in the invariant structure of optical information available directly to those able to attend to and acquire such information, and (c) even with some limitations, point-light displays are a useful tool in isolating these invariants.

The Ecological Approach

"Each thing says what it is - a fruit says `eat me'; water says `drink me'; thunder says `fear me'; and woman says `love me'"
- Koffka, 1935 (p. 7).

Introduction

The ecological approach to the investigation of psychological phenomena is set apart from traditional approaches to psychology. The theory originally posited by James J. Gibson[1] highlighted an animal's sensitivity to the structure of the energy available in the ambient array that invariantly specifies characteristics of importance to that particular animal (Michaels & Carello, 1981). Gibson in essence gave priority to *what* information might exist in stimulation that would permit an animal to achieve veridical perception of its particular environmental niche, rather than *how* animals make sense of such environmental stimulation. Gibson based such an argument on the assumption that stimulation is specific and not in need of calculation. Instead, Gibson speculated that information is structured energy that specifies properties of the environment significant to an animal, provided that the animal is sensitive to such structure in the ambient array.

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1 James J. Gibson, 1950, 1959, 1963b/1988, 1966, 1970, 1972/1982, 1974/1982, 1975, 1979. (see Lombardo, 1974, 1987; Michaels & Carello, 1981; Reed, 1988; and/or Reed & Jones, 1982 for an in-depth discussion of direct theory, information, affordances, and the other theories of James J. Gibson).

To further elucidate such an ideology requires a closer examination of the fundamental components of an ecological approach to the study of psychology. These components are:

(a) the appropriate unit of analysis.

(b) information.

(c) invariants.

(d) affordances.

(e) perception and action.

(f) perceptual learning.

The next section will discuss each of these topics from an ecological perspective and demonstrate:

(a) that perception as an adaptive activity guides biologically, psychologically, and socially functioning behaviours.

(b) how perceptual information is revealed in dynamic interactions with the environment of surfaces, objects, places, and other persons.

(c) that structured light and sound specify affordances (i.e., opportunities for action and interaction).

(d) how evolutionary design, personal history, intentions, and the current environmental context of the perceiver determine the perceiver's attunement to particular affordances of objects, places, and persons.

As Gibson (1979) stated, "An understanding of life with one's fellow creatures depends on an adequate description of firstly what these creatures offer and then secondly on an analysis of how these offerings are perceived" (p. 42).

The unit of analysis

As in physics, for Gibson and others (Alley, 1986, 1988, 1990; Baron, 1980, 1981; Ginsburg, 1990; Good, 1986, 1987; McArthur & Baron, 1983; Michaels & Carello, 1981; Reed, 1991; Runeson, 1985, 1988, 1990, 1994; Shaw & Bransford, 1977; Turvey, Shaw, Reed, & Mace, 1981; Zaff, 1989, 1995) the physical concepts of environment and the biological and psychological concepts applied to animals are fitted to one another in a larger system of mutual constraint. Therefore, such traditional concepts like perception and action should be viewed as activities which includes both animal and environment within a particular ecosystem and not taken solely as properties of the animal (Newtson, 1990; Shaw, Mace, & Turvey, 1994; Vicente, 1990). The underlying assumption in an ecological approach is that of ecological monism: the animal, the environment, and the interaction are studied as one ecosystem, not in isolation.

Such a monastic theory assumes the organism is active in and interactive with the environment in some way and information about action and interaction is chosen in the context of some useful, purposeful action (Garling & Evans, 1991). If, as Gibson believed, perception is the detection of useful information, and useful information is structured energy in the ambient array, and such information enables an animal to act in an adaptive way within its environment, then both animal and environment are mutually constrained and any study of one must incorporate the other.

Others put forward similar arguments. Vygotsky (1962) argued that the unit of analysis for psychological inquiry must retain all the basic properties of the whole. He maintained that these properties cannot be further reduced or divided without the subsequent loss of the actual properties themselves. Still and Good (1992) echoed the idea that to be meaningful, the study of psychology had to include both the organism and the environment within which it functions.

Such arguments were presupposed by Gibson as early as 1950. His theory of perception in the visual world implied that the animal, the environment, and the interaction between animal and environment should be the functional unit of analysis for psychological inquiry. Later, when expanding upon his theory of affordances, Gibson suggested that external stimulation is information for the animal about an environment, and how that information is organised or structured could be informative in its own right. More over, there exists a partnership of mutual constraint between the animal and its environment (Gibson, 1972/1982, 1975, 1979). As Ginsburg (1990) suggested, perception from an ecological perspective "is a relational phenomenon, dealing with certain aspects of the perceiver-environment relation" (p. 357).

However, if the interaction between animal and environment is to become the unit of analysis for psychological endeavour, then one must note Gibson's (1950) argument that such interactions between an active perceiver and an informing environment take place in space and over time. Therefore, the dynamic *event*, comprising the animal, the environment, and the interaction between the two, becomes the unit of analysis for psychological investigation.

Such a principle runs contrary to the traditional concept of absolute space and time which constrains perception to the 'now' and suggests that perception of dynamic events takes place in space-time (Michaels & Carello, 1981). An ecological, direct approach to perception supports Newtson and Engquist (1976) who argued the most distinctive characteristic of ongoing behaviour is change over time. Newtson (1990) elaborated further, suggesting that the unit of psychological analysis is the animal-environment ecosystem and this ecosystem is observable in space over time. Ginsburg and Smith (1993) agreed, stating that the object of study for psychology should be the structure of the "temporally extended environment in which the perceiver is active" (p. 196), thereby supporting Gibson's contention that perception is of events, not of objects isolated in space and time (Michaels & Carello, 1981).

Event perception then, like all perception, is the perception of sequential information (Johansson, von Hofsten, & Jansson, 1980; Verbrugge, 1985). It is evident that from an ecological perspective the proper unit of analysis for psychological inquiry is the animal-environment ecosystem as it unfolds in space over time.

Information

> "...the other person has a surface that reflects light, and the information to specify what he or she is, invites, promises, threatens, or does can be found in the light" (p. 136).
> - Gibson, 1979.

To examine the animal-environment ecosystem as it unfolds in space over time requires an understanding of the nature of the information available to an active perceiver that specifies temporally extended events. What is required to support such a unit of analysis is a functional definition of information. Gibson (1961) argued that information is the structure that specifies an environment to an animal and that such information is carried by higher-order patterns of stimulation, often over time (see pages 9-13 for a discussion of invariants). As Michaels and Carello (1981) explained, such patterns are informative about the world. In Gibsonian terms, information about something means specificity to something; in other words, meaning is specified in the structure of the ambient array (Gibson, 1966).

Lee (1974) echoed Gibson's theory that there is a lawful structure in the global array and that the structure in the stimulation available to a particular animal able to attend to that information constitutes information about the world. Gibson (1966) made the case that the senses are perceptual systems that pick-up facts about the world and that "stimulus energy, unless it has structure, conveys no information" (p. 245). Michaels and Carello (1981) explained Gibson's argument by asserting that information is the bridge between animal and environment. They suggested Gibson explained information as bi-directional structure in the ambient array that carries higher-order patterns of stimulation which may specify an environment to an animal. Runeson and Frykholm (1983) claimed the ability to perceive something "rests on the availability of information to specify it in the domains of the sensitivity of the perceiver. Hence, the viability of the ecological approach hinges on whether a good case can be made for the existence of such information" (p.586).

Gibson's (1961) ecological optics was a description of such information available in the ambient array of light reflected and re-reflected from surfaces. He showed that the array was highly structured at each of the extremely large number of station points available in a setting. For example, for a group of people standing in a large dining room, the flat surface of the dining room table is uniquely specified by the structure of the light reflected from the flat table top to each individual in the room, regardless of their location within the room. Movement of the perceiver in the environment, on the other hand, makes available to that perceiver a spatio-temporal pattern of optical structure which is characteristic of the path of motion. Again, with relation to the table top, if an individual were to slowly sit down on a chair in the room, the changes in angles from the light reflected from the table top is mathematically linked to the individual's direction of motion. Therefore, the structure in the ambient array not only specifies the table top, but the motion of the individual as well.

Gibson illustrated how the array specifies the real environment, and with motion, specifies it uniquely relative to the animal. But if structure in the ambient array defines information, then a further understanding of such structure is necessary to accommodate an understanding of psychology from an ecological perspective.

Invariants

Gibson (1950) argued that invariants are patterns of stimulation which are left unchanged over space-time while other aspects of the array are undergoing transformation. Invariants therefore are potentially informative about the environment and an animal's relation to it, and constitute lawful relations between objects, places, and events in the environment as well as the form, manner or structure of change in the patterns available in the ambient array. Gibson (1966) further argued that since stimulation occurs over time, as well as over space, and has temporal as well as spatial structure, invariants are present in the stimulus transformations over time. He argued it is the pick-up of these invariants that permits perception of the permanent properties of things, that these invariant properties specify the objects of the world and the layout of its surfaces. He further argued that these invariants may be under transformation, non-changing patterns of stimulation available in the evolving, changing, global array, and that such invariants are lawfully governed by the laws of physics and maths. He concluded that it is the invariant properties of the ambient array that carries information.

Michaels and Carello (1981) gave an account of Gibson's concept of invariants. They provided definitions of the two types of invariants, structural and transformational:

> **Structural invariants:** "properties that remain constant (an invariant pattern of stimulation over time) even though there are other properties that change" (p. 25). For example, the melody to `Yankee Doodle Dandy' is the same whether it is played on a piano, harmonica, or violin. The melody is a structural invariant that specifies the song.
>
> **Transformational invariants:** "the style of change in the medium that specifies the change occurring in or to the object, person, or event" (p. 26). For example, when an automobile goes around a corner, the transformational invariants specify the turning, while structural invariants specify the automobile.

Direct perception holds that these invariants (structural and transformational) are embedded in a continuum of space-time and may be picked up directly by perceivers with the capability of acquiring the information, and who are attending to that information available in the stimulation.

For example, many psychologists thought of 'constancy' as a developmental process of intellectual construction (Piaget, 1960). However, since stimulation occurs over time, as well as over space, and has temporal as well as spatial structure, invariants are present in the transformations over time. It may be the pick-up of these invariants that permits perception of the permanent properties of things (E.J. Gibson, 1969, 1991) as opposed to an internal process. Considering an event as a unitary occurrence in time with a beginning, a duration, and an end, then invariants over continuous transformations in time may be the basis for perception of that event. For example, Bassili (1979) showed the importance of temporal organisation in the recognition of emotions by demonstrating that parts of the face move together in characteristically different ways for different emotions. The facial transformations over time provided enough information for individuals to identify the nature of the emotion being exhibited by the target person. Shaw and Pittenger (1977) showed invariant structure in ageing faces and how that structure transforms over time in a lawful fashion retaining specificity to the individual face. Archer and Akert (1977) wanted to find out what it is in the interactions between people that informs the individuals involved as to the nature of their relationship. They found that transformational invariants available in the optical array could specify such social events such as parenting, winning, and friendship.

It appears that invariant structures may not only specify objects, places, and events in the environment, but also the activities of the animal. McArthur and Baron (1983) suggested that while the physical appearance of humans reveal certain structural invariants (backbones, limbs, erect posture), transformations of the physical structure may reveal invariants that directly specify the nature and meaning in social interaction. Good (1986, 1987) conducted an experiment that showed participants could make very accurate identifications of social events, such as an unwanted sexual advance and a teacher reprimanding a student, when viewing events devoid of all but the structural information of movement.

Vicki Lee (1988) agreed that the meaning of social events may be specified in the ambient array by arguing that "conduct has structure and the structure of conduct is the proper object of research and theory in experimental psychology" (p. 119). Likewise Smith and Ginsburg (1989) submitted that an invariant, when detected, constitutes the opportunity for the animal to behave in a particular way; in other words, afforded a particular action potential. Gibson (1966, 1972/1982, 1979) believed that invariants are available to perceivers able to acquire such information and that these invariants can be picked up over time by perceivers. Shaw and McIntyre (1974) argued that the acceptance of invariants means "placing psychological, physical, and biological phenomena on equal footing within a framework of an objective reality that favours none of them but accommodates them all" (p. 359). This approach provides an integrated framework that appreciates the constraints inherent in the relationship between the psychology of the animal and the laws of physics and biology existing in the natural world. This mutuality of relationship is an important difference between the ecological and cognitive approaches to psychological inquiry.

McArthur & Baron (1983) suggested that "we have learned much about the processing of information and little about what that stimulus information is" (p. 215). The ecological approach, unlike previous, more traditional approaches, offers a functional definition of information. From an ecological perspective, information is the structure in the ambient array that specifies an environment to an animal with direct relation to the particular animal's sensitivity to that information and the animal's ability to act on that information. Gibson's concept of affordances distinctively brings the animal and environment together in a system of mutual constraint.

Affordances

The ecological approach argues for an animal-environment monism, linking animal and environment into a relationship of mutual constraint. Nowhere is this linkage more evident than in Gibson's theory of affordances. Gibson (1979) defined the affordances of the environment as "what it **offers** the animal, what it **provides** or **furnishes**, either for good or ill" (p. 127)[2]. Gibson explained that the term implies a *complementarity* of the animal and environment. In his theory of affordance, Gibson believed that the functional utility of certain objects or configurations of objects needed to be attached to the action capabilities of the animal. He maintained that the functional utilities or action possibilities may be specified in the physical properties of environmental objects or object

[2] Use of bold as in Gibson's original text.

complexes, thereby providing information for perception that directly specifies the affordances available a particular animal provided that animal is capable of acting upon (effectuating) such an affordance (Gibson, 1979). Again, the environment and the animal within that particular environmental niche are both specified in Gibson's theory of affordances.

Shaw, Turvey and Mace (1982) provided a more functional explanation of an affordance:

> "A situation or event X affords action Y for animal Z on occasion O if certain relevant compatibilities between X and Z obtain" (p. 211).

They also defined the action capabilities of the animal (effectivities) with relation to the environment:

> "An animal Z can effect action Y on an environmental situation or event X if certain relevant mutual compatibilities between X and Z obtain" (p. 212).

In other words, the behaviours the animal is capable of are constrained by the environment. The two are in a relationship of mutual constraint and one cannot be specified without reference to the other. Affordances and effectivities are innately relational. As Greeno (1994) suggests, neither an affordance nor an effectivity can be specifiable without specifying the other as both operate in a state of mutual constraint.

According to Gibson (1979), it is the affordances on offer within a particular environment that are perceived by an active, exploratory animal.

Michaels and Carello (1981) suggested that when animal and environment are viewed as a single, mutually constraining unit, then animals are born to detect and learn to detect the affordances of their environment through perception and action. Reed and Jones (1982) agreed, arguing that active perception is controlled by a search for the affordances of the environment and active behaviour is controlled by the perceiving of these affordances (Gibson, 1972/1982, 1974/1982, 1975). Gibson (1979) emphasised that affordances must be taken with reference to an observer but are not "properties of the experiences of the observer. They are not participative values" (p. 137). Gibson found support from Ginsburg (1990) who suggested an animal perceives what behaviours can be entered into with respect to the environment. Such an argument places *meaning* as the equivalent of affordance, thereby making meaning directly detectable in the ambient array and not a mental construct.

Researchers into body and ability scaling offer support for Gibson's arguments (Mark, 1987; Warren, 1984; Warren & Whang, 1987; Zaff, 1989; Zohar, 1978). For example, Warren (1984) found that the perceptual boundaries between climbable and unclimbable stairs corresponds to a constant proportion between the height of the step and the individual's leg length. Mark (1987) studied eye height and its relationship to the maximum height of a chair participants considered they would be able to sit upon. He found a constant ratio between the perceiver's eye height and the height of the chair.

If an individual's physical size and abilities as well as his/her activities restrict the kind of information that he/she finds useful, a theory of perception must incorporate action. From an ecological perspective, the activities of an individual are "assumed to always be constrained by an interaction between the individual's capabilities and the properties of the environment that envelops that individual" (Zaff, 1995, p. 238). The animal and the environment are in a system of mutual constraint and one cannot be studied in isolation from the other.

Inherent in Gibson's theory of affordances is an active, perceiving animal capable of exploratory and performatory action. Exploratory actions discover the affordance properties of environmental objects, places, and/or events, while performatory actions exploit the perceived affordances (Owen, 1993). According to Reed (1988), Gibson defined the difference between the two as one of intentionality. Reed believed that intention is the active, striving nature of perception when an animal is seeking information and not merely having it presented to him/her, and argued that intention and interaction are functional variables within events. Zaff (1995) further illuminated intention describing it as the detection by an individual of a particular set of invariants from the total available inventory of invariants available to that individual within a particular environmental event. He argues that it is the intention of the individual that determines the particular affordances that the individual chooses to take into account with relation to a particular event or situation.

To illustrate this concept, imagine a running person stopping by a fence. The fence may afford leaning against (resting) if the runner is tired.

However, if the person is being pursued by a potential mugger, the fence may afford hiding behind (avoiding being mugged). In each instance (resting or avoiding) the intention of the individual determines the behaviours afforded by the environmental property (the fence). Thus, an explanation of how the perception of affordances constrains an individual's behaviour is taken only when referenced to the intentions of the individual and that those intentions are compatible with the individual's "relationship to its surroundings" (Zaff, 1989, p. 30). The ultimate goal of the individual is specified by the selection of criteria congruent with the intentions of that individual (Turvey, et al., 1981). According to Zaff (1989), "once the final condition of some nested event has been specified with respect to the intentions of the individual, his or her attention will then be directed toward the particular set of affordances that will result in the performatory activities appropriate to satisfy those intentions" (p. 30). Intentionality becomes specifiable, exists in the world, and is tractable.

The ramifications of affordance theory serve two purposes with reference to social psychology. According to Baron and Boudreau (1987) it provides firstly a "deeper insight into certain phenomena that are jointly relevant to personality and social psychology" (p. 1223). For example, an individual's mood may be specified directly by the patterns of their behaviour, and these patterns of behaviour are structural and transformational invariants which can be picked up directly in the ambient array by other individuals capable of attending to such information.

Secondly, affordance theory may provide a "model for how one might achieve a conceptual integration between personality and social psychology" (p. 1223) by providing a common unit of analysis.

Baron and Boudreau proposed that affordances are both objective and participative within a relationship of mutual constraint between the animal and its environment and that there exists in each environment "a plethora of nested affordances, only some of which are appropriate to any given animal" (p. 1223). If meaning is detectable in the affordance properties of objects, places, and events, and intention is specifiable, exists in the world and is tractable, then human interactivity must be governed by the same laws. If so, then social affordances, as well as the intentions of individuals, should be detectable within an interactive event between two or more individuals.

However, it must be noted that affordance theory does not suggest or even infer that perceivers will always be correct in their identification of the affordance properties of environmental stimuli. As Gibson (1979) stated, affordances are what the environment "offers" (p. 127) the animal. It does not necessarily mean that the animal will take advantage of that affordance. Attention to the wrong or different information is allowed for within an ecological framework. Furthermore, Gibson (1979) argued that perception and action are linked, with perception taking place over time. Such a theory allows for changes in not only what the environment affords an individual at any point in time, but also the needs and intentions of the individual within that environment. When being chased by a mugger, a fence may afford hiding behind, but once the chase has ended, that same fence may afford resting upon. Again, the individual and the environment are mutually constraining over space and time and perception takes place over time.

This is a radical departure from the traditional, cognitive view that person properties are internal and not specified in the environment but constructed in the head. From a cognitive view, the perceptual system is transparent as stimulus energy impinging on the receptor cells must by necessity be processed and manipulated internally before individuals can make decisions or judgements enabling action. This theory ignores the possibility, as proposed in an ecological approach, that perceivers are sensitive to certain information in the ambient array and that that information may be informative in its own right and not in need of processing.

In relation to social psychology, McArthur and Baron (1983) suggested socially important qualities such as dispositions, emotions, or moods are specified by the structure in the ambient array for perceivers available and able to detect it. Berry and Finch Wero (1993) discovered links between dispositional properties and facial appearance. They found that participants were able to predict a target person's social dominance, interpersonal warmth, and honesty from the structure of their faces. Such a result suggests that social perception could be the activity of attending to the invariant structure in the social environment and what it may afford the perceiver.

This argument is at odds with cognitive theories for several reasons. Firstly, cognition assumes a mind-body dualism in which perception is the end product of a chain of causal events that begin in the world and finish up inside the head of the animal (Smith & Ginsburg, 1989). The emphasis is on how the perceiver makes sense of the world as a passive observer separate from it. It might be suggested that processes proposed prior to a careful examination of the specificity of information available in the ambient array is, at the very least, premature. There is evidence that animals have evolved "smart mechanisms" (Runeson, 1977b) able to detect certain environmental information. These mechanisms are not transparent at all, but selective and able to pick-up information directly (Turvey et al., 1981). There appears to be an evolutionary relationship of mutual constraint between the animal and the environment that is not dualistic and has evolutionary significance.

Secondly, theories of cognition require an internal representation of the world with the unit of analysis a schema or category subserved by cognitive processes such as abstraction, generalisation, classification, and storage. In cognition, something needs to be added to perception by way of the mediating process (E.J. Gibson, 1969). Cognitive theories are attempts to understand how the individual makes sense of the world. Direct theory and the ecological approach instead examines what there is in the ambient array that informs the individual directly and suggests information exists in the ambient array that is informative in its own right and not in need of organisation or extension in the mind.

Thirdly, cognition assumes information existing in the world is inadequate or non-specific. McCabe (1986) suggested that cognitive theories with both an empiricist and Kantian heritage consider information as either unstructured, overwhelming, or hidden, thus requiring some form of processing by the mind. However, there appears some circularity in the reasoning that requires some foreknowledge of the meaning of input in order to select which of the many schema or categories to activate. As argued by Turvey and Shaw (1979), the nonspecificity of input should cause some alarm for cognitive theorists. It does not appear, even from a cognitive perspective, that input can be nonspecific. If it was, then each and every schema or categorisation must be matched against each and every input. Given that the cognitive approach considers the perceptual system to be transparent to all information, this appears to be an inefficient and laborious process. Although such processes cannot be ruled out entirely, a case appears to be building from an ecological perspective that the outcome of inferential processes cannot be "indifferent" (Runeson & Frykholm, 1983, p. 587) to the available information.

Perception and action

Nested within Gibson's theory of affordances is the link between perception and action. From an ecological perspective, affordances are the ordinary referents of perception and action. Central to this approach is the argument that perception is the pick-up of useful information. The activity is considered "direct in the sense of not entailing inference or similar constructive operations on insufficient input data" (Runeson & Frykholm, 1983 p.586). There is evidence of specialised receptor cells (Runeson, 1977b) and sensitivity to units of behaviour, such as critical changes in joint angles (Newtson & Engquist, 1976), which supports direct perception.

However, as discussed, what and how information is detected is constrained by the needs and intentions of the animal. As action engenders perception, the formation of the "animal's action system can constrain the form and timing of its own regulation" (Michaels & Carello, 1981, p. 51). Animals and their environments are entrained as mutually constraining systems (Baron & Boudreau, 1987; Cutting, 1982) as action is constrained by perception and perception by action. Michaels and Carello (1981) stated this as follows; "the action system (effectivity structure) and the environment (affordance structure) are in a relationship of mutual constraint" (p. 54). This suggestion that action and perception operates as a system with specificity to the individual perceiver, that organisms detect invariants or collections of invariants that specify the behaviours afforded by the object, place, and/or event, indicates the individual and the environment do indeed operate in such a system of mutual constraint.

Gibson further argued that perception and action are relational and non-deterministic in that perception is the active exploration of the ambient array, the search for available information, and the optimising of its pick-up. According to a direct approach, what structure is selected for attention by the animal becomes part of the animal's repertoire of potential detectable features of the environment provided that what is selected is affirmed as useful. Perception of events is, therefore, task specific, the task the perceiver is performing interacts with information in stimulation to effect strategies of perceiving as well as what is perceived, making perception and action inseparable (Michaels & Carello, 1981). McArthur and Baron (1983) also noted that perception serves an adaptive role for the animal inasmuch as it informs and is informed by action.

If perception constrains actions in such a way so that useful aspects of the environment are continuously revealed, then actions themselves have potential to be used as metrics. However, as Owen and Warren (1982) argued, the measure of performance needs to be relational with some parameter of information available to the individual, and these measures of performance could only be determined from the variables and invariants under the control of the individual involved. So, if perception is continuously revealing useful aspects of the environment, and occurs in space over time, then the structure of stimulation will have flow. Heft (1990) argued that perception is not limited to a moment in time. Move perception away from the 'now', and it is possible to discover that stimulation is tractable in prior interactivity, inherent in current interaction, and may project into the future. Action could be tractable (and measurable) through past behaviour, current behaviour could be immediately observable, and future action could be predictable. Thus, by measuring action, perception can be empirically tested without placing unnatural constraints on the participant. Such results could then be transferred into the real world and offer an empirical alternative to traditional cognitive approaches. By taking the ecosystem as the natural unit of analysis, researchers can examine psychological phenomenon considered intrinsic in cognitive theories. Such concepts as dispositions, traits, emotions, and moods move from the realm of being inside the head, to tractable, measurable, even predictable actions observable within the flow of stimulation available in dynamic events.

Perceptual learning

> "...practice seems to increase precision of discrimination of variables actually present in stimulation, and to detect relevant variables or distinctive features not previously detected" (p. 33).
>
> - E.J. Gibson, 1963.

As mentioned previously, perception is not passive reception, but an active, adaptive and regulatory search which focuses on useful stimulation in the ambient array (E.J. Gibson, 1969). In humans, for example, the process begins in the newborn infant with visual attention to certain stimulus properties in the optical array that carry information, such as motion and edge sensitivity. In the infant's development of object perception, for example, objects gradually become differentiated from one another by their distinctive features. Size and shape are differentiated within the first few months, even before the baby can walk or reach, and object constancy develops early in life (E.J. Gibson, 1991). Differentiation of the environmental layout may also develop without having to be supplemented with knowledge, involving information-processing, invoking schemas/scripts, and/or any other constructive processes.

Ecological research supports arguments in which invariant structures are picked up by infants without prior experience of events. For example, the visual cliff experiments of E.J. Gibson and Walk (1960), the facial perception and recognition studies of Bassili (1978) and Fantz (1966), the optical looming experiments conducted by Schiff (1965), the infant voice recognition findings of DeCasper and Fifer (1980) and the results of intermodal learning experiments using infants by Bahrick (1988) all lend support to this argument.

Even further support comes from Newtson, Engquist, and Bois (1977) who argued "perception is an ongoing, interactive process. The perceiver monitors the stimulus for certain kinds of action-defining information, and, when suitable information is picked up [at what they call a 'breakpoint'], the search is modified in that that information becomes, in part, a basis for discrimination of the next action unit [breakpoint]" (p. 857). They found that certain portions of the overall movement of individuals in action were more specificational than others, and participants could make accurate identifications of actions when exposed to only these small portions of the event. In other words, they found that perceivers do not necessarily need to pick-up all available information, but that lower-order invariants may specify higher-order ones. In essence, they argued that structure may not need be wholly apparent for accurate perception of events. Perceivers may need (and learn) to attend to only certain parts of the information available to make sense of the world. Runeson (1990) argued that skill acquisition is learning to attend to certain information available in the ambient array with particular specificational properties for a particular event, and that experienced experts learn over time what information to attend to in order to make accurate identifications of such events. These findings supported the case made by the Gibsons (1955a, 1955b) who considered the psychology of perceptual learning to be about learning to perceive more of the differentiating qualities of stimulation in the environment rather than increasing the animal's ability to differentiate through associated responses as a result of past experience. The Gibsons argued that "the main difficulty in the way of the traditional enrichment theory is its implication that learning involves a decreasing psychophysical correspondence between perception and stimulation" (Gibson & Gibson, 1955b, p. 448). They contended that perceptual learning consists of responding to variables of physical stimulation "not previously responded to" and suggest the notable point about this theory is that "learning is always supposed to be a matter of improvement – of getting in closer touch with the environment" (Gibson & Gibson, 1955a, p. 34).

Perceptual learning is adaptive but does not change the environment. Instead, perceptual learning is gaining an increasing understanding of the adaptive relationship between the environment and behaviour. Consequently, attention should be focused on the interaction between animal and environment and stimulation should not be considered simply energy impinging upon a perceptual system constructed wholly of transparent receptor cells (E.J. Gibson, 1969). It may be the extraction of information that characterises perception, and it is the increasing ability to extract this information that characterises perceptual learning and development.

The criterion of perceptual learning, then, is achievement of greater specificity between stimulation and discrimination, increasing differentiation, and pick-up of invariant relations. Perceptual development, then, is the development of perceived invariants. The criterion of perceptual learning is an increase in specificity, the increased ability to acquire and differentiate progressively finer levels of invariant structure.

As Gibson (1950) suggested, perceptual learning is the education of an animal's attention, and attention is the selective aspect of perception (Pick, 1979). Adaptive modification of perception should result in better link between the information available to an animal in the ambient array and the events, objects and/or places that are the sources of stimulation. In addition, as E. J. Gibson (1969) argued, such adaptive modification of perception should enhance the ability of the animal to use the potential stimulation available. Barwise and Perry (1983) suggested that specificity of information must be contingent upon existing constraints and these constraints can vary from natural laws to conventions and/or temporary agreements between individuals or groups of people. This argument prompted Runeson (1990) to suggest that skill acquisition could occur through modification of how one uses one's perceptual system rather than through some cognitive process with functioning occurring in the perceptual mode entirely.

From the perspective of ecological-social psychology, E.J. Gibson's (1969) perceptual differentiation theory suggested that perceptual attunements develop at the same time as the development of behavioural abilities. According to McArthur and Baron (1983) there may be much to learn "about the development of social perceptions (i.e., the social invariants to which perceivers at a given developmental level are attuned)" (p. 220) from an analysis of the "behavioural goals that the social perceptions can serve" (p. 220). McArthur and Baron (1983) suggested that at "the most fundamental level, there must be a match between the animals' receptor capabilities and the stimulus information to which they are perceptually sensitive" (p. 218) arguing that "perceptual systems have evolved to be sensitive to the types of structured information available in a given ecological niche" (p. 218), and this would include social events. In phylogeny there appears then to be evidence within animals of an increasing differentiation between invariants in the ambient array and a continuing progression of the capacity of the animal to detect higher-order invariants in the flow of stimulus information.

The research of Berry (1991b) lends support to such an argument. She showed that although both adults and children could correctly identify the sex of moving point-light faces at a greater than chance level and greater than the accuracy levels found for static facial displays, it was beneficial for children (but not adults) to be provided with socially elicited patterns of facial behaviour in a sex identification task. Her results suggest that as people grow in maturity they become more sensitive to finer levels of invariant structure and can abstract and differentiate higher orders of invariant structure, certainly in relation to sex differentiation. This finding supported E.J. Gibson's theory of perceptual learning as well as an ecological approach to the study of social events.

Summary

From an ecological perspective, the study of perception is the study of the interaction between animal and environment within a particular eco system (Vicente, 1990). Information, defined as invariant structure in the available ambient array, provides contact between the animal and the environment. Information then is referenced with respect to the animal-environment relationship that it specifies as well as the animal to whom that relationship is specified. Gibson's theory of affordances argued that the cooperative nature of animal and environment, when allied with perception and action, leads to the argument that animals are born to detect and learn to detect the affordances of their environment directly (Michaels & Carello, 1981). As such, affordances are the primary referents of perception. From an ecological perspective, the purpose of perception is to constrain actions in such a way as to continuously reveal useful aspects of the environment (i.e., perception constrains action and action constrains perception). Perception is relational in nature in that the objects of interest are animal-environment relations. Therefore, as Heft (1989) suggested, to examine perception and action it is necessary to accept that the animal is an active participant within a particular environment, that the interaction between animal and environment is relational with respect to what the environment has to offer and what the animal is capable of effectuating, and that behaviour must be viewed as a stream over time. An affordance then equates to functional meaning and the natural transformation of meaning over time (evolution) through continued interaction between the animal and the environment. Inherent within such an approach is the link between perception and action, and the possible acceptability for researchers to utilise actions instead of perceptual reports.

Whereas ecological science traditionally examined the biological basis of environmental stimulation impinging upon the transparent receptor cells of the animal, ecological psychology focuses on the examination of the information transactions *between* animals and their environments. The physical concepts of environment and the biological and psychological concepts applied to animals are fitted to one another in a larger system of mutual constraint. As suggested by Shaw, Mace, and Turvey (1994) the traditional psychological concepts (for example, perception, action and knowing) may no longer be viewed solely as properties belonging to a particular animal, but as activities of an ecosystem that includes both animal and environment in a system of mutual constraint. The implications for traditional social psychology are to re-examine the basic unit of analysis and the methodology applied to such an exploration, and to use an ecological, monistic approach to the study of social interaction as part of an animal-environment ecosystem.

This study took an ecological approach to social event perception by using point-light techniques that reduce stimulation in the optical array so that only the motion patterns of the actors was available to participants. The aim was to determine if perceivers could accurately identify the nature of dyadic social events when presented with whole-body patterns of movement. In other words, can the structure of whole-body movements of individuals involved in a social event provide enough information for perceivers to accurately identify that event? And if so, will perceptual learning take place over repeated exposure to events? However, before such a task can commence, it is important to discuss point-light techniques and the theory behind them.

The Kinematic Specification of Dynamics and the Utility of Point-Light Displays

> "One may create versions of the original stimulus in which particular aspects of the stimulus are systematically degraded or subtracted out until only the dimension to be studied remains" (p. 150).
>
> - Berry (1990c)

Introduction

Heider and Simmel (1944) were among the first to suggest motion patterns may be of significance in social perception. Gibson (1966) too was interested in visual motion patterns. He suggested that optical information could guide locomotion in animals by specifying both the invariant surrounding surfaces and the movement of the animal within them. Michotte (1963) was the first to study biomotion when he examined the perception of larva motion. Johansson (1973) later defined biological motion as "the motion patterns characteristic of living organisms in locomotion" (p. 201). Runeson and Frykholm (1981) combined the ideas of informational invariants and biological motion in studies using point-light displays[3] to examine the visual perception of lifted weights. They concluded that the weight of the box was specified in the kinematic information available to perceivers, and that the visual system was

3. Point-light techniques use reflective patches attached to actors so that when events are filmed or video-taped, replay can be adjusted in such a way as to only exhibit the patches which appear on the screen as lights. Such techniques devised by Johansson in 1973 are a means of providing kinematic information to participants. See pages 48-54 for a full discussion of point-light techniques.

efficient at picking up such information. They argued that if dynamics was taken to mean "anything that has an influence on the course of an event" (p. 733), and perceivers could pick-up this information directly from the ambient array, then, as suggested by Gibson (1979), such animal-dynamic properties as intention or mood should be specified in the ambient array "without having much to say about what properties of shape or motion conveyed the information" (Runeson & Frykholm, 1981, p. 733).

This suggestion prompted Runeson and Frykholm (1983) and Runeson (1985, 1994) to argue there were relations of specificity between properties of movement and persons, and these properties were not hidden or intrinsic as suggested by traditional cognitive theories, but specified in the kinematic information available to a perceiver viewing a dynamic social event. For Gibson, Runeson, and others (Alley, 1990; Michaels & Carello, 1981; Newtson, 1990, 1994; Shaw & Bransford, 1977) information available for perception is specific, has validity extending over time, and is meaningful. There appears to be information embedded in the patterns of moving, interacting organisms to specify not only the nature of the event, but also the person properties previously considered 'hidden' such as the moods, intentions, and emotions of individuals (Berry, 1990c; Berry & Finch Wero, 1993;. Berry & McArthur, 1986; Good, 1986). That these properties are available to perceivers and are specified in the structure of information, is the basis of an ecological approach to social psychological inquiry.

According to Good (1987) social perceivers are aware (a) of the properties of others; (b) they share such knowledge with others; (c) they acquire knowledge in the presence of others who do likewise, and (d) they explore their environments in pursuit of their goals. Good's findings fitted nicely with Gibson's (1974/1982) argument that people are not only parts of their environment, but also perceivers within it. Gison suggested that within social environments, individuals perceive not only other perceivers, but also what the other perceivers are perceiving. According to Gibson, in this way social observers are aware of a shared environment which is common to all, not just belonging to the individual observer. Gibson (1979) suggested that this reciprocality of affordances is lawful and, while it may be involved, such mutuality is based on the pick-up of invariant information in the ambient array. Gibson suggests therefore that the social psychology of knowledge is based in ecological optics and in the individual's ability to pick-up the optical invariants over time.

The existence of social invariants has empirical support. Berry (1991b) found that systematic relations exist between particular patterns in stimulation and particular social perceptions such as gender sensitivity, and, furthermore, perceivers can be quite adept at extracting this information. Hodges and Baron (1992) showed that artifacts and actions of physical-social settings revealed values as well as laws and rules, and Berry and Misovich (1994) demonstrated that the structural and dynamic characteristics of people were lawfully related to their dispositional qualities.

While the argument for an ecological approach to social psychology appears to be gaining interest, how does one get at the information specifying the nature of social interaction and the previously 'hidden' person properties inherent in a cognitive premise? Runeson (1977a) provided a good starting point with the development of his *KSD* principle – the kinematic specification of dynamics.

The kinematic specification of dynamics - the KSD Principle

Runeson (1977a) applied the concepts of physics to the study of event perception. From the field of physics he utilised the concepts of *kinematics* and *dynamics*. Physics defines kinematics in relation to displacement, velocity, and acceleration which are primarily derived from distance and duration. Variables used to report change in the "geometrical configurations" (Runeson & Frykholm, 1983, p. 588) of an event over time are assigned to the area of kinematics. Physics explains *dynamics* as variables (such as mass, momentum and force) that "cause or constrain motion" (Runeson & Frykholm, 1983, p. 588). According to Runeson and Frykholm (1983), variables involved in influencing a particular course of events are considered to be in the "domain of dynamics" (p. 588). Todd and Warren (1982) agreed, asserting that kinematics considers aspects of pure motion without need to refer to the potential forces or masses involved, while the various forces involved in motions or maintaining a stable system state fall into the domain of dynamics. Runeson and

Frykholm (1981) further suggested that as soon as a "minimum degree of complexity is exceeded, the kinematic patterns of events contain information about relevant dynamic properties" (p. 733). Johansson (1973) then Runeson and Frykholm (1981, 1983) and subsequently numerous other researchers (Berry, 1990a, Bingham, 1993; Good, 1986, 1987; Mather & West, 1993) have used point-light techniques to show the informativeness of such kinematic information.

If information is available in the kinematic pattern, it is also available as higher-order properties of the optic array, thus making direct visual perception of dynamic properties possible. Although Runeson's analysis dealt with inanimate objects, he argued that similar principles hold true for events involving living organisms (Runeson, 1985, 1988, 1990, 1994; Runeson & Frykholm, 1981, 1983). He suggested that by taking dynamics in the wider sense to mean anything that has an influence on the course of an event, one might include moods, intentions, expectations, dispositions, and abilities to be specified in the ambient array. This argument suggested that social events and dyadic interactions might fit comfortably into the realm of dynamics.

Runeson posited his *KSD*-principle, which stated:

> (1) Dynamic factor *a* influences the kinematic shape of movement *M*.
>
> (2) Hence, the kinematics of *M* specify *a*.

The *KSD*-principle, stated simply, is that movements specify their causes through structural and transformational invariants available in the optical array to animals who are capable of picking up such information and who are attending to it.

For example, representations of animate activities have turned out to be easily produced by synthetic displays of moving and changing geometrical figures (e.g., Bassili, 1976; Heider & Simmel, 1944; Runeson, 1977a), suggesting visual perception is fundamentally linked to whatever dynamic aspects may be indicated in the kinematics as opposed to being linked to the kinematics in isolation. It has been argued that these specificational dynamics may have social relevance by specifying such traits as intentions (Heft, 1989) and emotions (Runeson & Frykholm, 1986). Indeed, the laws of physics appear to apply equally to social interaction. Runeson and Frykholm (1983), Berry (1990a, 1991a,b), Berry and Finch Wero (1993), Berry and Springer (1993), Bingham (1993), Cutting and Kozlowski (1977), Good (1986, 1987), and others have shown that kinematic information is linked to such social phenomenon as deceptive intent, sensitivity to changes in facial patterns, recognition of friends by their gait, and accurate perception of simulated social events.

According to Runeson and Frykholm (1986) change of one dynamic factor cannot "be substituted for or cancelled by change in another" (p. 262). They argue that the multidimensionality and nonlinearity of animate motion can "simultaneously yet separately" (p.262) specify different dynamic factors in the kinematic pattern. The anatomical make-up of an animal constrains its movements by limiting what the animal can or cannot physically do and is also a major determinant as to what shape the movement of the animal will finally take (Runeson & Frykholm, 1986). Reed (1982) suggested that the occurrence of pre-adjustment of posture is a universal feature of an animal's action system. This prompted Runeson (1985) to argue that the human anatomical system is designed so that each particular action incorporates the required postural compensations and sensory feedback prior to such compensations is not an obligatory requirement. Rather, Runeson (1986) argued that "active and reactive effects are lawfully related through mechanics and the action system is organised to take advantage of this" (p. 59) lawful relationship. Therefore, the *KSD*-principle stated that movements of individuals specify the causal factors of events in the world and that the nature of the event is specified as well as the activities, current, past, and future, of the individual(s) involved.

A closer look at deceptive action helps to illustrate this argument. The findings above suggest that deceptive action should, at best, only be able to recreate some of the kinematic details of an intended activity, but other aspects of the kinematic pattern will be altered in such a fashion as not to be congruent with the intended activity. In other words, information available in the ambient array may actually specify the intent to deceive as well as the real nature of the actual event. Therefore, it could be suggested that both the true conditions and the deceptive intentions are available in the kinematics of the event to a perceiver able to attend to such information. Indeed, the research into deceptive intent by Runeson and Frykholm (1983) and Bingham (1993) showed that perceivers were adept at picking up information specifying deception in a simple lifted weight experiment. Their results supported the argument that the kinematic pattern inherent in action is useful information in its own right for the perception of dynamic properties, even person properties that, from a cognitive perspective, are considered hidden or intrinsic.

However, despite the utility of Runeson's *KSD*-principle, Runeson and Frykholm (1983) suggested there were some restrictions on the use of kinematics. These are:

> (1) "Kinematic specification can be effective only in some activities, notably those where the property in question is a sufficiently strong contributor to the unfolding movement. Vigourous whole body movements will generally be more appropriate" (p. 598).

> (2) "Perception requires not only potential information but also corresponding attunements of the perceptual system. Informational specificity is not to be equated with perceptual saliency. Depending on property concerned and activity observed, person-in-action perception may range from the simple noting of the obvious to requiring the utmost of educated attention" (p. 598).

(3) "Facial expressions, gestures, styles, and so forth, are not rendered inefficient by kinematic specification. Kinematic specification should instead be viewed as an addition to the informational support for social knowing with particular value for perceiving true, as opposed to expressed, conditions" (p. 598).

The present study examined these three suggestions. However, to do so required a further understanding of both biological motion and motion events.

Biological motion

Johansson (1973) considered biological motion as the "motion patterns characteristic of living organisms" (p. 201). In forward locomotion the rotational movement of the various limb segments in a coordinated, angular motion creates a smooth sinusoidal curve around the human's centre of mass. This invariant pattern uniquely specifies forward locomotion in humans. In addition, each person's unique body proportions produce a different variation of this figure-eight pattern that can specify even more specific characteristics of that particular individual such as sex, age, and even identity (Kozlowski & Cutting, 1977; Montepare & Zebrowitz-McArthur, 1988; Montepare & Zebrowitz, 1993; Runeson & Frykholm, 1983).

Newtson (1990) argued that a "sequence of different actions consists of a succession of different dynamical systems" (p. 168). He found that each action requires reorganisation of the body into different coordinative structures with new specificity to "actor and observer" (p. 168) alike[4]. Newtson, Engquist, and Bois (1977) had earlier measured these successive reorganisations by assessing the changes in joint angles. As these specificities change, they argued that information flows into or out of the system. In other words, as movement changes so too does the kinematic structure, and what that structure specifies at any given point in time may change as well. Therefore, behaviour consists of a flow of movement within an interaction and a flow of information in and out of that interaction. Newtson, Hairfield, Bloomingdale, and Cutino (1987) found such information flow to be highly periodic. They argued that information flow in interaction between two persons is significantly coupled ("interaction is joint action" (p. 233)) and a constant, observable phase relation is maintained. They also suggested that such invariants are do not reside in the head of the individual, but in "their relation to their environment" (p. 233), making such information directly available to the perceiver. Furthermore, Newtson et al. confirmed the existence of points of definition (action unit boundaries to the shifts in coordinative structures) or breakpoints (Newtson, 1976), and these breakpoints are found in ongoing action. Newtson (1990) argued that these breakpoints contain sufficient information to specify the behavioural waveform from which they are drawn, that these waves are coupled in interaction, and

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[4] Turvey (1990) provides further evidence and discussion on synchronous coordinated activity.

that this information is directly observable and measurable through analysing behaviour.

Results such as these are contrary to any representational argument that might be forthcoming and is one reason for advancing an argument based on specificity in perception and action as opposed to cognitive representations. If, as Newtson (1994) suggested, a stable, dynamic system is created when the various units of the body are coupled with the forces in the environment, then the result is a human action system that is constrained from a biological perspective and realised by the establishment of surrounding body structure, not cognitive structures. These particular configurations of the body require the constraints of the environment to operate smoothly. The system then exists in the relationship between the animal and the environment, including variables in the animal and in the environment with the animal's body components organised to fit the task at hand. In such a system, the animal specifies the environment and the environment specifies the animal.

Runeson and Frykholm (1983) argued that to the extent that emotions determine movements, they are "specified in the kinematic pattern by biomechanical necessity" (p. 612). In other words, emotion, intention, mood, and other previously considered intrinsic or hidden properties of people are physical forces subject to the lawful relations inherent in the *KSD* -Principle. Therefore, as Runeson and Frykholm (1983) and Runeson (1994) suggested, kinematic information in a dynamic event may specify such activities. This study examined such a position.

The ability of perceivers to accurately identify the nature of three different dyadic social events was tested with each dyadic event specifying a particular relationship between actors ranging from anger to happiness to a more neutral everyday meeting of friends.

Motion events

The Gibsonian view that perception and action are inextricably linked in an animal-environment eco-system assumes interaction; interaction designates an event in which there is some effect[5]. As Berry and Finch Wero (1993) suggested, useful information is most likely revealed in dynamic, multimodal stimulus events that unfold over time, and perceivers are fairly skilled at extracting information from the stream of behaviour, and under some conditions are able to do so very rapidly. Ambady and Rosenthal (1992) showed that the accuracy of social judgements based on length of exposure to samples of behaviour was just as good for participants making 30 second observations of behaviour as it was for those viewing the behaviour for a full 4 minutes. Research into the visual perception of non-animate and animate events, such as collisions (Todd & Warren, 1982), muggings (Grayson & Stein, 1981), social actions (Good, 1986, 1987), facial and vocal changes (Berry, 1991a), ageing effects on social perceptions (Berry & McArthur, 1986; Berry & Zebrowitz-McArthur, 1988), perceiving lifted weights (Runeson & Frykholm, 1981),

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[5] Oxford Paperback Dictionary defines **interact** *v.* "to have an effect on each other. **interaction** *n.*"

and deceptive intent (Runeson & Frykholm, 1983) has established the existence of structural and transformational invariants in motion events with specificational information available to an animal able to detect it.

Even supposedly 'hidden' internal dynamic properties of objects and persons can be visually perceived when viewing events, and results strongly suggest event perception involves perceiving dynamics (Runeson, 1985). Runeson argued there is a firm informational basis for direct perception of persons-in-action and persons-in-interaction. He concluded that for persons-in-action, specific kinematic patterns are visually available for detection through the pick-up of invariant structures existing in the ambient array. He further suggested that such invariant structures are lawfully related to automatic and biological factors of the animal that, over time, determine distinctive acts or actions that are specifically goal-oriented. In the social environment, Runeson suggested that people have available to them immediate information about both what others are doing and what others intend to do in action over time. Patterns of movement of an animal in an event interact with the information in the environment to produce systems that specify the animal-environment relation itself and such systems can be dynamically stable. Runeson suggested these systems extend in space and time and can produce self-organising structures with apparency over time, therefore constituting an event.

Runeson further argued that each object or event specified has some permanence over time and an animal can remain informed of the nature of an event or object even in the absence of continuous sensory contact

(Bingham & Runeson, 1988). In other words, the kinematics may specify the intended dynamics of an event without the event actually eventuating.

To illustrate the argument that intention may be specified in the kinematic patterns inherent in action, imagine a person starting to rise from a seated position. The activity of starting to rise exhibits a postural kinematic pattern available to the observer, the person is about to get up from the chair. However, as has happened to all of us, just as you are about to get up from your seat, something on the television stops your intended exit. The kinematics specify your original intention of getting up, yet the actual dynamics of rising do not eventuate.

Runeson (1985) believed that "the actually occurring kinematic pattern is indeed specific for the conditions that generated it" (p. 48) and perceivers can be sensitive to discrepancies in this pattern. What is important, according to Runeson, is that co-ordinative structures are "set up more or less in advance of action, and thus may prevail in the system for extended periods even when the person is not moving at all" (p. 60). Runeson suggested that "movements are specific to all those aspects of the person that influence the movements" (p. 60), and available to perceivers in the form of "complex invariants definable over the total kinematic pattern of an event" (p. 60). If an observer can accurately report on the properties of a target person or persons, then information specifying those properties must exist in the ambient array, be available to, and be attended to by the observer.

Baron (1990) agreed, suggesting that different dispositions generate characteristic event profiles with affordance information given perceivers who are prepared to "detect or discover what they can do to or with environmental entities" (p. 138). If presentation is in kinematic form only, it could be concluded the person properties identified are specifically involved in shaping the movements in the event (Runeson, 1985). These two points are extremely relevant to nonverbal research in that kinematics may specify the intentions, expectations, emotions, and moods of the target person, and perceivers can obtain this information directly and accurately without having to evoke schemas and/or scripts. These mutuality relations may be fine-tuned at two levels; the information level, and at the level of acquisition (Baron, 1990). Active information pick-up sets the ecological position apart from the traditional cognitive approaches to psychology in that it considers that useful information not only exists in the world but at the same time has meaning that can be regulated and controlled by the animal (Putnam, 1988).

According to Runeson and Frykholm (1983), to produce discriminable effects, actions must exceed a certain degree of vigorousness to provide the perceiver with enough kinematic information to make veridical judgements. Human beings have evolved a perceptual system attuned to transformations in the structure of the ambient array, and these patterns, available across space and time, specify the nature of events (Berenthal & Profitt, 1984; Johansson, 1973; Kozlowski & Cutting, 1977; Mace & Shaw, 1974; Mather & West, 1993; McCabe, 1986; Runeson &

Frykholm, 1981, 1983). According to McCabe (1986) when something moves, or appears to move by a change in the perspective of the observer, the patterns produced by the transformations specify the identity of the object or person, or the nature of the event. Consequently, it can be argued that it is unnecessary to abstract, represent, or construct objects, persons, or events inside the head if they are already specified and available in the ambient array. Invariants (structural and transformational) therefore not only specify the object, person, or event, but are actual properties of the object, person, or event. McCabe (1986) further argued that since many objects, people, and/or events share many invariant properties (i.e., humans stand erect and walk on two legs, most birds have two wings, table tops tend to be flat), it might be useful to reverse the similarity/equivalence equation and propose that equivalent things are similar because they are related, not related because they are similar (Quine, 1973).

This argument should hold equally true for events involving more than one individual, with many social events exhibiting the same or nearly identical invariant structure at one or more levels, but differences at one or more other levels. However, although the information may indeed be available to perceivers, the pick-up of relevant information may vary across events and perceivers. Differences between individuals could be a result of variations in perceptual learning, the education of attention during the pick-up of structure in the ambient array specifying the nature of particular events (E.J. Gibson, 1963, 1969). This study considered such a proposition by examining events in an effort to discover whether or not (a) perceivers could make accurate discriminations of dyadic social events in free-verbal and forced-choice response conditions, (b) repeated exposure to events would result in more accurate forced-choice identifications of those events, and (c) educating a perceiver's attention as to the possible nature of events would have an impact on their accuracy in identifying events.

Point-light techniques

Point-light displays provide a method for isolating what contribution kinematic information makes in specifying the dynamics of events. According to Runeson (1985) "any state or characteristic of a person that has physiological aspects or consequences that could influence the action system are within reach" (p. 59) using point-light displays. Johansson (1973) suggested that his point-light techniques secured the proximal stimulus in a "geometric-kinetic analysis" and that such anchorage is a "consequence of the insight that all the information available" (p. 210) is given in the optical array. In other words, information is available in the dynamics of motion, is lawfully governed, and available to perceivers in the ambient array. Johansson argued that such information can be effectively studied using point-light techniques. Good (1986) stated that point-light displays are effective research tools for social psychologists for three reasons:

(1) as social interaction is an active event, such displays provide natural and active stimulus configurations.

(2) such configurations are free from contextual or situational information that may provide confounding or contradictory information.

(3) point-light displays "provide a means of assessing just how little stimulus information" (p. 8) is required for veridical perception of social events.

Indeed, research to date suggests a high degree of utility for such a technique. Johansson (1973) found that perceivers could rapidly and consistently identify walking human figures from as few as five pairs of lights. He also discovered using point-light displays that participants could readily identify running, climbing, and cycling. He even found that people could quickly identify human couples involved in the social interactivity of dancing. In each case Johansson stated that "spontaneous and correct identification of the types of activity was made without exception" (p. 204). Perhaps controlling the location and number of lights could also prove beneficial in determining just which, if any, of the locations and/or particular movement patterns were more or less informative.

Evidence that human movement could specify sex was found by Cutting and Kozlowski (Cutting & Kozlowski, 1977; Kozlowski & Cutting, 1977) even though their displays were very brief, supplying observers with limited information over time with which to make their judgements. These results were expanded upon by Runeson and Frykholm (1983) and confirmed earlier results that perceivers can use kinematic movement in events specifying not only sex, but the nature of events under investigation. They demonstrated that kinematic point-light displays supported perception of sex, activity, intention/expectation, and apparent intention (either deceptive or emphatic). McDaniel and Odom (1983) used point-light techniques to report that infants demonstrated a visual preference for facial expressions of emotion over static displays or face-shaped masks.

Good (1986, 1987) reported results of a pilot study on the perception of social interaction and suggested observers could determine from point-light displays of kinematic motion which social event they were viewing, some with very high levels of accuracy. For example, Good (1986) showed that participants in a 7 choice forced-choice experiment could identify a chance meeting of old friends 100% of the time when presented with kinematic information only. He showed that even complex dyadic events, such as a headmaster reprimanding a pupil or an unwelcome advance at a disco, were adequately specified in the kinematic information for participants to make high levels of identification, 77% and 95% respectively. He concluded that the kinematics of biological motion in social interaction can be informative enough to specify the nature of intentional social actions. Montepare and Zebrowitz-McArthur (1988) used point-light displays to find significant agreement among judges for impressions of previously 'hidden' person properties such as dominance, happiness, industriousness, approachability, and sexiness. They also demonstrated that a person's gait serves as a potent source of information about a variety of personal attributes.

It appears that the gait of an individual may specify more than just the dynamics of movement. Grayson and Stein (1981) found that the 'muggability' of a person was specified in the gait of potential victims. They had criminal respondents view videotapes of individuals walking through a high crime area of New York City and rate each individual on their potential for assault. Differentiation of movement categories revealed that the typical victim would not have a medium stride, as expressed in terms of body-scaled dimensions, but a stride either longer or shorter than the mean. They also found that individuals rated high in muggability also tended to lift their feet while walking as opposed to exhibiting a fluid swing movement, and they moved their arms and legs unilaterally as compared to the contralateral leg and arm movement of non-victims. Grayson and Stein concluded that non-victims tended to have an organised quality about their body movements as compared to victims, and criminals were particularly adept at attending to this information. In other words, to a potential mugger, the muggability of an individual is specified in the kinematic transformations of the individual over time.

Other research has shown that perceivers can pick-up information specifying person properties from kinematic information. Berry (1991b) discovered that both adults and children could correctly identify the sex of transforming point-light faces at greater than chance level, and that the accuracy levels for moving point-light faces was greater than those found for static facial displays of point-light faces. Berry (1990c) also reported that "rapid facial events reveal veridical differences in the physical and social power of children and adults" (p. 149) and argued that "perceptions of power were grounded in the patterns of motion that characterised the displays, rather than derived from an inferential process mediated by age labelling" (p. 149). She suggested that properties of an individual structures the information available in the ambient array and that such structure provides meaning to other individuals. Mather and West (1993) determined that participants could accurately identify various animals by their biological motion as viewed in point-light displays. Stoffgren and Flynn (1994) assessed sensitivity to the deformability of support surfaces and demonstrated that "this sensitivity can be based solely on kinematic stimulation" (p. 33). They argued it is possible to "present second-party stimulation to observers that is both natural and solely kinematic" (p. 37).

It is clear that research to date supports the use of point-light displays as a method of isolating the contribution of kinematic information in specifying the dynamics of events. Such a method has some obvious characteristics that make it especially appropriate for the study of social perception. Firstly, point-light displays can provide control over events (either real or simulated). Researchers can either isolate particular actions or simulate specific events in a controlled environment. According to Good (1986) point-light displays can provide informational support for even rather subtle properties. Secondly, by controlling the number and/or placement of lights the researcher has control over a measurable amount as well as the location of information. Thirdly, variation of number and/or placement provides the researcher a technique to identify and isolate particular patterns of motion with particular specificational properties. Finally, point-light displays provide a possible technique to isolate parameters of information that inform perceivers by using situations in which those parameters may be manipulated or isolated in a controlled manner (Berry & Misovich, 1994).

Although research to date suggests the application of point-light displays exhibits usefulness for the study of the social events, there are also suggestions some constraints may need to be placed on their usage (Good, 1986,1987; Runeson & Frykholm, 1983). It has been suggested that the subtractiveness of point-light displays can pose problems (Good, 1986). To date there has been little research to determine what information can be subtracted without reducing the informativeness of the displays. For example, when does kinematic facial information need to be included in displays as opposed to whole-body kinematics only, or the other way around? When information from whole-body displays is not enough to allow for accurate identification of an event, do perceivers then actively search for and attend to other information, such as facial movement, to make such identifications? Is it possible that perceivers firstly attend to whole-body kinematics to identify events, and if that information is not available or inadequate they then attend to facial information? Could there be an order to information pick-up when identifying social events? This study examined the accuracy of participants to identify the nature of dyadic events when presented with a whole-body kinematic only display of dyadic events compared to a full-view version of the same events (where all visual information, including facial information was available) and tried to discover if whole-body displays are adequate for examining all dyadic social events.

Differences between sexes

Most research into the proficiency of perceivers to accurately acquire kinematic information from dynamic events has shown few significant differences between males and females. However, recent research by Bernieri, Davis, Rosenthal and Knee (1994) suggested this issue may be in need of further investigation. Using a quantised display, they measured the relative movement coordination occurring within dyadic social interaction (i.e., interactional synchrony). Bernieri et al. found very high correlations between synchrony ratings made from normal video displays and those made from quantised mosaic displays. They also established that interactional synchrony was "positively correlated with interactant rapport reported by females but not with the rapport reported by males"(p. 308).

Research has also described females as more interpersonally oriented and expressive than males (Spence, Deaux, & Helmreich, 1985) and generally more accurate than males at nonverbal behaviour perception (Hall, 1984). Bernieri et al. concluded that "the combined effect of greater interpersonal orientation and superior nonverbal sensitivity may make females more susceptible than males to the social consequences of interactional synchrony"(p. 308). Research suggests that females attend to more interpersonal information available in dyadic social events than do males. This effect supported earlier findings by Rosenthal, Hall, DiMatteo, Rogers, and Archer (1979) who reported that females are more attuned than males to expressive information, however they did not define the nature of the information to which females might be more attentive.

Smith, Archer, and Costanzo (1991) suggested perceivers are aware of nonverbal information and are sensitive as to when they are using such information accurately. They reported that females have the ability to be more sensitive to the specificational nature of the stimulation available in social events than their male counterparts and that they are more adept than males in attending to nonverbal information. When viewed from an ecological perspective, the perceiver picks up the information specifying the nature of a social event directly, and neither conscious or unconscious processing of that information may be required.

However, to date, there has been little other empirical evidence to suggest differences between females and males in the attention to and the pick-up of salient kinematic information inherent in movement of individuals involved in social interactivity. This study looked for differences existing between the sexes and their sensitivity to transformations in the optic array specifying the nature of dyadic social events.

Summary

Johansson (1973) reported that motion patterns have been found to "carry all the essential information needed for immediate visual identification" (p. 210) of human motion. He suggested that it is not previous learning about motion patterns which determine the perception of walking, for example, but that the "highly mechanical, automatic type of visual data" (p. 210) that is most important. This supported the contention within direct theory that transformations in the optic array are the information specifying motion events. As argued by Runeson and Frykholm (1983) if the "detailed kinematic pattern is specific to an active and acting person's anatomical make-up and to the working of his or her motor control system" (p. 585), then information is therefore potentially available about properties of that individual including "gender, identity, expectations, intentions, and what the person is in fact doing" (p. 585). If information about the dynamics of an event is available in the kinematics to perceivers with direct sensitivity to that information, then it could be that such person properties previously considered internal or hidden may also be specified in the dynamic kinematics of event perception. That is, aspects of traits, emotions, and dispositions, may be kinematically specified and perceivers may be sensitive to such structure in the ambient array, not requiring inferential processing to be able to identify them.

This notion of sensitivity to structure in the ambient array explains how direct identification of simple and complex informational invariants is possible without the cognitive requirement of computation and/or representation. Relating to the field of social psychology, the *KSD* principle allows for the rejection of the supposition that person properties are hidden and therefore only recognised through a causal process of registering behaviour and then attributing possible internal or external causes for such behaviour (Alley, 1990; Berry, 1988; Good, 1986; McArthur & Baron, 1983; Runeson, 1985,1988,1990,1994; Runeson & Frykholm, 1981,1983; Smith & Ginsburg, 1989; Valenti & Good, 1991).

Evidence suggests that in perceiving events individuals do not see movements as such, but are able to pick-up the structure specifying the dynamics underlying the movements. According to Smith and Ginsburg (1989) mounting evidence suggests that socially produced stimulation nested within social events is extremely rich in information (Becklen, 1985; Berry, 1990a, 1990b; Berry & McArthur, 1986; Berry & Finch Wero, 1993; Runeson & Frykholm, 1983). Research on event perception has isolated some of these high-order, invariant patterns in human movement and shown that they effectively specify properties of human action and interaction, various characteristics of the actors involved, and particular behaviours. These patterns are directly detectable by human observers who are attentive to them. As Gibson (1979) proposed, "an understanding of life with one's fellow creatures depends on an adequate description of what these creatures offer and then on an analysis of how these offerings are perceived" (p. 42). Such a theory directly challenges cognitive models of social and causal perception that presume the nonspecificity of input (Smith & Ginsburg, 1989).

Experiment: The Kinematic Specification of Simulated Dyadic Social Interactions Using Point-Light Displays

Introduction

The following of experiment took an ecological approach to examine the ability of perceivers to accurately identify the nature of three dyadic events from the dynamic kinematics inherent in such events, and tested the usefulness of point-light displays for such an endeavour. Based upon the arguments discussed, the following predictions were made:

(1) Participants exposed to both full-visual and kinematic only information will be able to make accurate identifications of three simulated dyadic events at acceptable levels. Those levels have been set at better than chance in the forced-choice condition (33%), and better than 40% in the free-verbal condition. This level of 40% accurate identification has been arbitrarily set as it requires participants in the free-verbal response condition to be more accurate than but not significantly above the chance levels of 33% for the forced-choice conditions.

(2) Participants in the whole-body kinematic viewing condition will make significantly fewer accurate identifications of dyadic events than participants exposed to the full-view version of events.

(3) Vigorousness of gestural animation will have an effect on the frequency of accurate identifications of the simulated dyadic events in the kinematic only condition with participants making more accurate identifications of the more vigorous events.

(4) If attunement increases specificity, then participants provided only three choices prior to viewing in a forced-choice identification task (each choice representing one of the three dyadic events) will make significantly more accurate identifications of dyadic events with repeated exposures to the same events.

(5) If perceptual learning takes place across trials, then participants will make more accurate identifications with repeated exposure to the simulated dyadic events.

(6) Females will be more adept than males at identifying the nature of dyadic events.

Method

Experimental Design

This study adopted a 3 (dyadic event: E1/E2/E3) x 2 (viewing condition: full-visual (FF)/kinematic only (KO)) x 3 (response condition: free-verbal (FV)/forced-choice 1 (FC1)/forced-choice 2 (FC2)) x 2 (event tape: St1/St2) x 2 (sex: male/female) x 2 (direction of entry of actors: male entry right (DR)/male entry left (DL)) experimental design (see Table 1).

Table 1.
The 3 x 2 x 3 x 2 x 2 x 2 experimental design.

Events x (3) x	Viewing Conditions x (2) x	Response x Conditions (3) x	Event x Tapes (2) x	Sex x (2) x	Directions of Entry (2)
Event 1 (E1)		Free Verbal (FV)			
	Full Visual (FF)		Tape1 (St1)	F	Male Right (DR)
Event 2 (E2)		Forced-Choice1 (FC1)			
	Kinematic Only (KO)		Tape 2 (St2)	M	Male Left (DL)
Event 3 (E3)		Forced-Choice 2 (FC2			

Video-recording of events

All interactions were recorded in the large television production studio at the New Zealand Broadcasting School, Christchurch, New Zealand. A television lighting expert was used to ensure that placement of studio lighting provided optimum recording quality for each condition.

Actors were filmed using a Hitachi Z31 Computacam and recorded on a JVC BR-5605EB video cassette recorder. Editing was conducted using a National AG-A650 Editing Controller, two National AG6500 video cassette recorders, and two Philips, 14-inch colour display monitors.

The full-view (FF) condition was videotaped under normal studio lighting conditions with a neutral, tannish-grey curtain behind the actors. Actors wore neutral, dark clothing and all jewellery or other items that might be distracting were removed.

The kinematic only condition (KO) events were videotaped using techniques very similar to those utilised by Johansson (1973) and Runeson and Frykholm (1981, 1983). High-grade, industrial, silver reflective tape was used for the reflective patches. To ensure visibility of the point-lights, actors movements were side-on only at all times. Reflective patches were 40 mm in diameter and placed only on the side of the body nearest the camera. Eight reflective patches were placed as follows on each actor: just above the ear, neck, shoulder, hip, knee, ankle, elbow, and wrist. A black curtain was draped behind the actors to provide a darkened background in contrast to the reflective tape. Actors wore dark clothing and dark make-up was applied to the actor's faces and hands to ensure no reflectant leakage occurred from bright areas of skin. Lighting was in front, above, below and on both sides of the actors to ensure an even light distribution to reflective patches. When recordings were viewed by participants, the displays appeared as a configuration of bright spots against a black background.

Two recordings were made of each dyadic event, one with the female entering from screen right, the male from screen left, and the other with the entrance directions reversed. To control for the distance between the actors, they were instructed that for each simulation they were to walk to specified points marked on the floor with green tape. These marks were exactly 800mm apart. To control for speed of approach, actors were instructed to walk toward each other at a constant speed for each interaction. Any trials where the experimenter or the television consultant did not believe the actors either achieved their marks or maintained a constant approach speed were terminated and re-recorded. In a further effort to control possible variance between individual actors, the same actors were used for all recordings. The actors were both of medium build with the female and male 1.70 and 1.75 meters in height and 20 and 21 years of age respectively. In post-production, each simulation was edited to a duration of 12 seconds. For all recordings, camera placement remained constant at 4m from the actors.

The dyadic events

The three dyadic events were as follows;

(E1) good friends meeting after not seeing one another for several weeks,

(E2) good friends meeting as they do several times every day, (E3) good friends meeting after having had an argument earlier in the day.

The actors were given the following instructions prior to the recording of each event:

E1: You are good friends but have not seen one another for several weeks. You are meeting in the hallway at the university prior to a class. You are very happy to see your friend again and when you meet, you are to lean towards one another, hold hands, and kiss each other briefly on the cheek. Then stand back with both feet on your marks and release hands. You are to then chat in an animated, excited fashion making both hand and head gestures of a relatively excited, friendly, and expansive nature. Ensure that such gestures are made with your hands nearest the camera. Continue until I say 'cut'.

E2: You are good friends who spend a lot of time together and meet everyday for coffee or a chat. You are meeting in the hallway at the university prior to a class. While you are happy to see one another, it is no big occasion. You are to smile at one another and chat in an animated fashion as good friends would do. You are to make small, infrequent hand and head gestures, and refrain from making larger, more exaggerated movements. Ensure that any such gestures are made with your hands nearest the camera. Continue until I say 'cut'.

E3: You are good friends meeting in the hallway at the university prior to a class. Earlier in the day you had a disagreement about some money that is owing and that feeling is still quite strong. The female is still angry about the situation while the male is feeling a bit guilty. Consequently, upon meeting, the female is to adopt an aggressive hands on hips pose and tell the male that she is still mad at him, while the male is to avoid eye contact by looking downwards and is to bring his hand nearest the camera to his chin and cross his other arm over his chest in a closed, defensive, submissive posture. The female is to discuss the issue of the money owing in an aggravated fashion and the male is to maintain the submissive pose until I say 'cut'.

Dyadic events were recorded in the following order; E1, E2 then E3.

As this study explores the effects of available visual information on judgemental accuracy, no audio was made available to participants.

Procedure

Participants viewed the simulated dyadic event recordings individually in a secluded, darkened room. A 14-inch Phillips monitor was used to display the events. In the kinematic only condition (KO), contrast was increased and brightness decreased on the monitor to ensure no leakage from reflections that may have occurred in the original recording of events. Playback was on a National NV-8500 Video Cassette Recorder located behind the participants and close to the experimenter. Audio recordings of the free-verbal responses were made on a Marantz Cassette Recorder using a small, unobtrusive lapel microphone.

Participants were instructed to carefully read the instruction sheet provided (see Appendix A) and then carefully read and sign the consent form (see Appendix B).

The experiment was in two parts. In part one participants' free-verbal responses were recorded and in part two they were required to make a choice from the three alternatives provided (Appendix C).
In part one, the experimenter explained to the participants;

> This is a task involving visual information. You are about to watch some video tapes of interactions between two people. The interactions may or may not be the same. The event will last for 12

seconds. At the end of that time I will ask you to tell me the nature of the interaction and relationship between the two people; in other words, what you think is going on between these two people, not just what movements you see. If you have no idea of what you think is going on, it is important to say so. You will have as long as you need to respond and I will record your answers on a cassette recorder for coding later. There will be six video clips for you to view and we will start now.

Participants then viewed each of the three dyadic events as videotaped from each direction for a total of six presentations. Responses were recorded for coding later.

In part two, the experimenter provided participants with an answer sheet (Appendix C) and provided the following instructions;

> I will now show you the same interactions randomly presented. You will be asked to make a choice from those provided as to the nature of the interaction you are viewing. The choices are the same for each interaction. Please take a moment to acquaint yourself with the three choices. Please record your answers on the answer sheet provided with a tick next to your choice. Each video clip is 12 seconds long, and you will have a further 8 seconds after the event has finished in which to record your answer before the next interaction appears. However, please feel free to mark your answer sooner if you think you are sure of your response.

Participants then viewed the tape of the dyadic events. Responses were recorded on the answer sheets and collected at the end of each session. Each trial lasted approximately 12 minutes.

Tapes were arranged to control for presentation effects by dividing the six presentations into two blocks and placing the following constraints on order of presentation (see Table 2):

(a) no two dyadic events could be sequential,

(b) no more than two dyadic event directions could be sequential,

(c) each of the six dyadic events must appear in each block.

Table 2.
Order of presentation by event and direction of entry.

Trial	Block I	Block II
1	E1 DL	E3 DR
2	E3 DR	E1 DL
3	E2 DR	E2 DL
4	E3 DL	E1 DR
5	E2 DL	E3 DL
6	E1 DR	E2 DR

The two presentation blocks were balanced by creating two event tapes (see Table 3).

Table 3.
Order of blocks for presentation.

Tape	Free Verbal	Forced-Choice 1	Forced-Choice 2
St1	I	II	I
St2	II	I	II

The design resulted in a total of 18 trials per participant.

At the conclusion of each session, participants were asked if they were happy for their responses to be used and any questions the participants had were answered by the experimenter. No participants chose to withdraw their responses.

Participants

The 48 participants who volunteered to participate, 24 female and 24 male, were students at either the Christchurch Polytechnic or the University of Canterbury, Christchurch, New Zealand.

Results

Coding of Free-Verbal (FV) Responses

Three coders (two female and one male drawn from the same population) were supplied with an answer sheet (see Table 4) and asked to listen to the free-verbal responses of each participant for each trial. They recorded their responses on the sheet next to the choice they believed most accurately represented the participant's response on each trial. Coders were not aware of any other aspects of the study. It was necessary for at least two of the three coders responses to match in order to give that participant's response a mark. If at least two out of the three coders responses matched, then that match was marked as the response given by the participant. All three coders responses matched 58% of the time, with responses by coders one and two matching 73%, coders one and three 68% and coders two and three 66%. Since at least two of the three coders had matching responses on all trials, it was not necessary to resolve any discrepancies between coders.

Table 4.
Answer sheet for coding of FV responses.

Trial	Response Choices
1.	___ good friends meeting after not seeing one another for several weeks. ___ good friends meeting as they do several times every day. ___ good friends meeting after having had an argument earlier in the day. ___ none of the above. ___ did not know.
etc.	

Data reduction and tests for accuracy

Firstly, for analysis of raw data, exact participant responses for each trial were entered into a spreadsheet. Proportions of accurate identifications for each of the three dyadic events by direction of entry, viewing condition, and response condition were calculated (see Tables 5, 6, and 7). Forced-choice responses were pooled as no differences were found between the two forced-choice conditions (see page 75).

In the forced-choice conditions participants were required to select one of three possible answers resulting in a chance level of .33. Due to the open-ended nature of the free-verbal condition, no level of chance could be calculated.

Table 5.

Proportion of accurate identifications for E1 by direction of entry of the male actor by response and viewing conditions.

		Free Verbal (FV)		Forced-Choice (FC1+2)	
Participant Response	Direction of Entry	Full Visual (FF)	Kinematic Only (KO)	Full Visual (FF)	Kinematic Only (KO)
E1	DL	.71	.63	.83	.52
	DR	.25	.50	.96	.92
E2	DL	.21	.38	.17	.42
	DR	.54	.46	.04	.04
E3	DL	.04	.00	.00	.06
	DR	.00	.00	.00	.04
None Above	DL	.04	.00		
	DR	.21	.02		
Don't Know	DL	.00	.00		
	DR	.00	.00		

Table 6.

Proportion of accurate identifications for E2 by direction of entry of the male actor by response and viewing conditions.

		Free Verbal (FV)		Forced-Choice (FC1+2)	
Participant Response	Direction of Entry	Full Visual (FF)	Kinematic Only (KO)	Full Visual (FF)	Kinematic Only (KO)
E1	DL	.13	.00	.06	.02
	DR	.04	.04	.00	.08
E2	DL	.63	.29	.94	.52
	DR	.63	.29	1.00	.71
E3	DL	.00	.17	.00	.46
	DR	.00	.17	.00	.21
None Above	DL	.21	.38		
	DR	.25	.29		
Don't Know	DL	.04	.17		
	DR	.08	.17		

Table 7.
Proportion of accurate identifications for E3 by direction of entry of the male actor by response and viewing conditions.

		Free Verbal (FV)		Forced-Choice (FC1+2)	
Participant Response	Direction of Entry	Full Visual (FF)	Kinematic Only (KO)	Full Visual (FF)	Kinematic Only (KO)
E1	DL	.00	.00	.00	.00
	DR	.00	.00	.00	.00
E2	DL	.04	.08	.00	.21
	DR	.04	.25	.00	.17
E3	DL	.79	.33	1.00	.79
	DR	.67	.58	1.00	.83
None Above	DL	.08	.50		
	DR	.29	.17		
Don't Know	DL	.08	.08		
	DR	.04	.00		

Table 8 reports proportion of accurate identifications for each of the three dyadic events in both the free-verbal and forced-choice response conditions. In the free-verbal condition, only participants attempting to identify the more neutral E2 dyadic event in the kinematic only condition failed to achieve a proportion of accuracy better than .40.

Table 8.
Proportion of accurate identifications by viewing/response conditions for each event.

Event	Full Visual		Kinematic Only		$\bar{X}$
	Free Verbal (FV)	Forced-Choice (FC1 + FC2)	Free Verbal (FV)	Forced-Choice (FC1 + FC2)	
E1	.48	.90	.56	.72	.67
E2	.63	.97	.30	.61	.48
E3	.73	1.00	.46	.81	.75
$\bar{X}$	.61	.96	.44	.71	

Chi-square analysis of frequency of identification for observed responses versus frequency levels expected due to chance in the forced-choice response condition was significant (X^2 (2)=643.51, p<0.01). Further chi-square analyses of forced-choice responses by dyadic event in each viewing condition showed that participants were able to identify all three dyadic events in both viewing conditions at better than chance levels (see Table 9).

Table 9.
Chi-square results for forced-choice responses by viewing condition compared to chance.

	Full-Visual Condition			Kinematic Only Condition			
	X^2	df	p-value		X^2	df	p-value
E1	136.6875	1	< 0.01	E1	64.1714	1	< 0.01
E2	174.4219	1	< 0.01	E2	34.1719	1	< 0.01
E3	192.0000	1	< 0.01	E3	99.1875	1	< 0.01

Responses for dyadic event by viewing condition by direction of entry revealed a discrepancy between direction-left and direction-right for E1 that was not apparent for the other two dyadic events (see Tables 5-7). For example, proportion of accurate identifications for E1 in the free-verbal response condition was .71 for direction-left (DL) but only .25 for direction-right (DR) (see Table 5) while differences between directions were minimal for E2 and E3. A similar discrepancy arose in the forced-choice responses for E1, only this time in the kinematic only viewing condition. In the kinematic- only/forced-choice condition, proportion of accurate identifications for E1 was .52 for direction-left (DL) and .92 for direction-right (DR), a reversal of the free-verbal results (see Table 5). Again, differences in proportion of accurate identifications in this condition for E2 and E3 were minimal. Such results suggested that either (a) the two E1 simulations (DL and DR) were in some way different from one another (i.e., they were not identical simulations), or (b) participants differed in their perceptions of the event depending upon the direction of entry of the actors in the simulations. This second possibility seemed least likely as the same effect was not apparent in either of the two other simulations. Furthermore, there was no consistency in participants' responses between viewing conditions. The proportion of accurate identifications for participants in the full-visual/free-verbal condition were the reverse of those in the kinematic only/forced-choice condition. If there was a difference in direction of entry (left or right) it would be expected to be consistent across both viewing conditions. This was clearly not the case. A visual review of the recorded events by the experimenter confirmed minor differences in movements between the two simulations for E1 by direction of entry. Although the differences did not appear major, it was certainly possible that even such minor variations in movement patterns could have accounted for the irregularity of results. In particular, for E1/DR in the full-visual simulation, the actors appeared to stand slightly behind their marks requiring them to lean further towards one another to kiss when compared to the E1/DL full-visual simulation. This may have resulted in the discrepancy in proportion of accurate identifications for E1 by direction of entry in the full-visual condition which was not apparent for the other dyadic events. The importance of the 'distance between' actors will be discussed more fully later (see pages 96-98). It appeared that direction of entry results for E1 may have been confounded by a lack of similarity between E1/DR and E1/DL, particularly in the full-visual condition. It was assumed the results for E1 was therefore not a function of direction of entry of the actors and for this reason, directions of entry were pooled over for the remaining analyses .

However, despite some apparent problems with E1, it was still apparent, as expected, that participants were able to accurately identify the nature of the three simulated dyadic events at better than chance levels in the kinematic only/forced-choice conditions, and that participants were able to identify at least two of the three dyadic events in the free-verbal response condition, with levels of accuracy above 40%.

Tests for effects

As a second method for treating data, participants' responses were marked `1' if they correctly identified the simulated dyadic event and `0' if they identified something other than the event viewed. Responses were entered into Statistical Analysis Software (SAS) with within-participant variables nested by event, direction of entry, and response condition. Between-participant variables were event tape, sex, and viewing condition. Proportions of accurate identifications were calculated for each condition for further analysis.

Analysis of variance of the 3 (dyadic event: E1/E2/E3) x 2 (viewing condition: FF/KO) x 3 (response condition: FV/FC1/FC2) x 2 (event tape: St1/St2) x 2 (sex: male/female) factorial design (pooling over direction of entry) showed significant main effects for response condition ($F(2,863)=51.32$, $p < 0.05$), dyadic event ($F(2,863)=5.16$, $p<0.01$), and viewing condition ($F(1,863)=52.51$, $p<0.01$), and a significant interaction between level of dyadic event and viewing condition ($F(2,863)=15.27$, $p < 0.01$). No other significant results were found.

A post hoc multiple comparison test (Tukey's Studentised Range (HSD) Test) for response condition (FV/FC1/FC2) showed no significant difference between proportions of accurate identifications between FC1 and FC2, but participants' proportion of accurate identifications in the FV condition was significantly lower than both forced-choice conditions (0.823, 0.840, and 0.524 respectively. Tukey's $p < 0.01$). This result supported the hypothesis that participants would identify the nature of the dyadic events more frequently in a forced-choice identification task than when allowed to provide unrestricted, free-verbal responses. The lack of a significant difference between FC1(0.823) and FC2 (0.840) did not support the hypothesis that perceptual learning would take place over repeated exposure to events.

The two main effects for dyadic event and viewing condition were qualified by the interaction between these two variables. The proportion of accurate identifications for levels of simulated dyadic event by viewing condition can be seen in Figure 2. A simple main effects analysis for each of the three dyadic events across viewing conditions showed a significant difference for E2 only ($F(1,863)=262.87$, $p<0.05$). Participants in the full-visual viewing condition made significantly more accurate identifications of E2 than those in the kinematic only viewing condition.

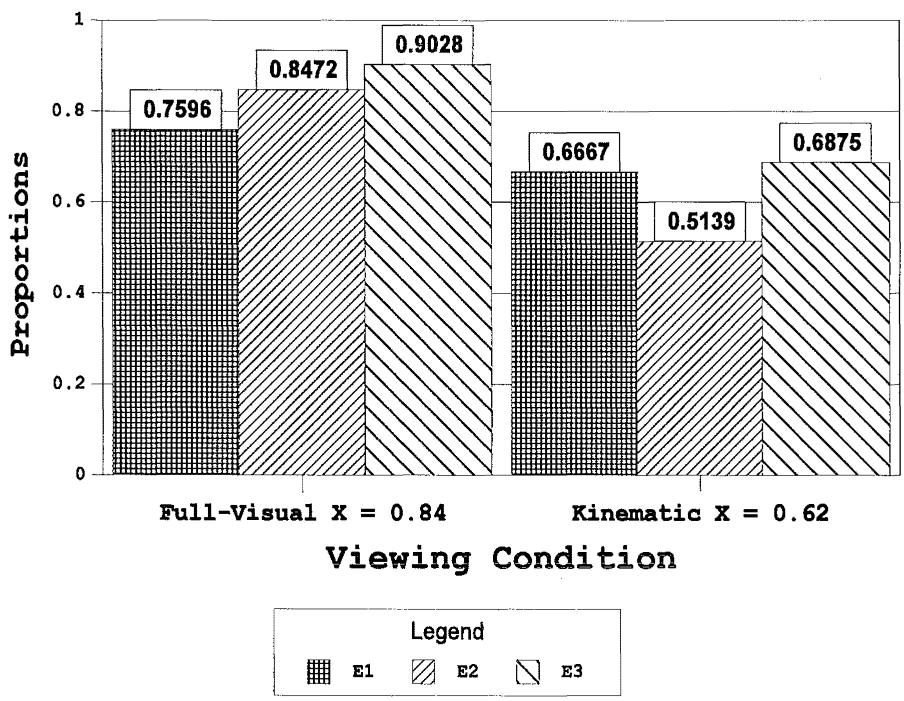

Figure 1. Proportion of accurate identifications for event type by viewing condition.

A simple main effects analysis for events applied to the two viewing conditions showed significant results for both viewing conditions; full-visual ($F(2,863)=284.76$, $p=<0.05$) and kinematic only ($F(2,863)=186.20$, $p<0.05$). A post hoc Tukey's Studentised Range (HSD) Test for significance was conducted for each of the viewing conditions. Results showed that in the full-visual viewing condition participants made significantly more accurate identifications of E3 than of E1 (0.903 and 0.760 respectively, Tukey's $p<0.01$). Results in the kinematic only viewing condition indicated that participants made significantly more accurate identifications of E3 and of E1 than of E2 (0.688, 0.667, and 0.514 respectively, Tukey's $p<0.01$). No other significant differences were found.

Results showed that the interaction between dyadic event and viewing condition was due to the differences in accuracy for E2 between viewing conditions. The lack of a significant difference by viewing condition for E1 and E3 does not support the prediction that participants would make more accurate identifications in the full-visual as compared to kinematic only viewing conditions for all dyadic events. This was only apparent for E2.

Results did support the second hypothesis that more vigourous gestural animation would result in increased accuracy of identification in the kinematic only condition. Both E1 and E3 appeared far more gesturally animated (i.e., there was more apparent bodily motion involved) than E2 (with visibly less movement apparent when compared to E1 and E3) and proportions of accurate identifications were significantly higher for E1 and E3 than for E2. However, level of gestural animation did not explain the significant difference between E3 and E1 in the full-visual condition. This difference will be examined more fully (see page 93).

Discussion

This thesis took an ecological approach to determine whether perceivers could identify the nature of dyadic events from the kinematic information available in the ambient array, and tested the usefulness of point-light displays for such an endeavour. It was hypothesised that although participants would be able to accurately identify all three dyadic events at acceptable levels in both viewing conditions, the reductive nature of point-light displays using whole-body kinematics would result in participants in the full-visual viewing condition (where all the visual information was available) making significantly more accurate identifications than those in the kinematic only viewing condition. This prediction was supported for only one of the three dyadic events under investigation and on the whole.

It was further suggested that events with high levels of gestural animation (E1 and E3) would be easier to identify than the more gesturally neutral E2 in the kinematic only viewing condition. This prediction found support as participants in the kinematic only condition identified the gesturally more animated E1 and E3 significantly more often than they identified the less gesturally vigorous E2.

It was anticipated that the proportion of accurate identifications for participants in the forced-choice conditions would be higher than those in the free-verbal condition, possibly due to attunement of the perceptual system. Results showed that participants in the forced-choice condition did make significantly more accurate identifications of all three dyadic events than those in the free-verbal response condition.

The prediction that perceptual learning would take place over repeated exposure to events found no support from the results of this study. There was no significant difference between the two forced-choice conditions.

Finally, it was anticipated that females would exhibit higher levels of accuracy across all conditions than males. Again, no support was evident for this hypothesis. Males and females showed no significant differences across any of the test conditions.

Accuracy of identification of dyadic events

In the forced-choice condition participants' frequency of identifications for all three dyadic events was above chance for both viewing conditions. This result held for each of the six event-by-viewing-condition combinations as well with the proportion of accurate identifications of dyadic events reaching very high levels for some dyadic events, particularly in the full-visual viewing condition. Results indicated that participants in both viewing conditions were able to make accurate identifications of each dyadic event when required to make a forced-choice identification of dyadic events.

As participants were provided no information about the nature of the dyadic events prior to or during the free-verbal response condition, and the fact that any possible response was available to them in the free-verbal response condition, no comparisons of frequency of identification compared to chance were available. Instead, an identification proportion over .40 was determined as acceptable in this condition. This level of accurate identification required participants in this response condition to be more accurate than but not significantly above the chance levels of 33% for the forced-choice conditions. Participants identified the simulated dyadic events in the free-verbal response condition with an overall accuracy of 53%. Accurate identifications by viewing condition was also above the acceptable level, 62% and 44% in the full-visual and kinematic only conditions respectively. Results supported the prediction that participants would be able to accurately identify the nature of the simulated dyadic events in both the free-verbal and forced-choice response conditions and that overall the simulated dyadic events adequately depicted the nature of the desired dyadic events. However, although overall levels of accuracy were acceptable, these results needed further explanation with reference to those found for levels of viewing condition, response condition, dyadic event, and the interactions between dyadic event and viewing condition. Differences were expected and found.

Accuracy by viewing condition and dyadic event

Participants in the full-view condition made more accurate identifications of E2 than participants in the kinematic only viewing condition. The suggestion that participants in the full-visual condition would make significantly more accurate identifications of all three dyadic events than those exposed to kinematic only information was not supported in this study for E1 and E3. There was enough information available in both viewing conditions for participants in each viewing condition to make similar levels of identifications of E1 and E3. However, results suggested that for E2, participants in the full-visual condition attended to information that was either not available, not attended to, or inadequate for participants in the kinematic only condition. It appears that whole-body kinematics were inadequate in accurately specifying the nature of E2.

Just why E1 and E3 were identified more frequently than E2 in the kinematic only viewing condition became apparent when differences between dyadic events were examined across viewing conditions. As expected, the more gesturally animated events (E1 and E3) were identified more accurately than the more neutral event (E2) in the kinematic only viewing condition, while no differences were found in the full-visual condition between E2 and either E1 or E3. This result supported the arguments of Runeson and Frykholm (1983) and Runeson (1985, 1990, 1994, 1995) that vigorousness of gestural animation increases specificity and has an effect on a perceiver's ability to identify events when viewing kinematic only information. Such a result again suggested that important information necessary for participants to make accurate assessments of E2 was either not available, not attended to, or inadequate in the kinematic only condition. This finding, and those mentioned above, suggest that usefulness of point-light displays in the study of dyadic events might have to be limited to events with relatively high levels of gestural vigorousness. It appeared that when gestural animation was low, participants in the full-visual viewing condition used information that was either not available, not attended to, or inadequate when presented in whole-body kinematic presentations. This possibility will be discussed in detail later (see pages 88-90 and 93-95).

One finding that was not expected was the significant difference in accuracy of identification between E3 and E1 in the full-view condition, with participants making more accurate identifications of E3 than E1. No differences were found between E1 and E2 or E2 and E3 in this viewing condition. It appeared this result may have been due to possible experimental design problems, particularly with reference to E1 simulations (see pages 96-98 for a detailed discussion).

Attunement

This study lent qualified support to the argument that attunement would lead to more accurate identifications of the three dyadic events. Participants in the forced-choice conditions made significantly more identifications of the simulated dyadic events than they did in the free-verbal condition. It appeared that by attuning their perceptual system to search for invariants specifying a limited number of possible dyadic events, and then asking them to perform an identification task, participants did significantly better than those in the unrestricted, free-verbal response condition. In other words, educating the participant's attention by providing them with the three possible dyadic events resulted in more accurate identifications. This result supported the argument that perception in the forced-choice condition was task specific; the task the perceiver was performing interacted with the available information to effect strategies of perceiving as well as what was perceived. In the forced-choice conditions, information detection was controlled and attunement was achieved through the narrowing down of the possible social invariants to which participants needed to attend to just the three available choices. The findings supported E.J. Gibson's (1969) argument that adaptive modification of perception results in a better correlation between the information available and the events being viewed, and supported the hypothesis that when attention was educated perceivers would be more capable of picking up the information necessary to accurately identify the nature of the simulated dyadic events.

However, for such an argument to be acceptable, the position of researchers such as Garner (1962) needs to be overcome. He proposed that if participants are aware of the set of alternatives in a task, then they are also aware of (1) the possibilities that could be presented, and (2) what responses are possible and permissible. Garner argued response discrimination and choice was a "critical factor in any perceptual experiment" (p. 38), and concluded that the degree and nature of the choice of responses was probably more important than the nature of the stimuli. In other words, it could be possible that the critical factor in the participants' performance was not due to the restriction in stimuli, but in the accompanying restriction in possible responses. For this experiment, proponents of response uncertainty theories would argue that the higher levels of accuracy in the forced-choice conditions were due to the reduction in possible responses as opposed to the attunement of the perceptual system.

At this point, the use of the word 'information' requires elaboration. Garner tended to consider information in the Shannon and Weaver (1949) and Attneave (1954, 1959) sense of 'bits', hence the view that information was a measure of uncertainty. However, the ecological view is that structure in the ambient array is the information available to a perceiver able to attend to it. Gibson (1966) considered information in the sense of specificity to something, not as a reduction in uncertainty. Information then is the means by which events are perceived, not simply sensory impressions (i.e., 'bits'). In other words, *events* are perceived and information is ordinarily transparent to perception. If one takes a direct approach to perception, that perceivers can and do directly detect information in the ambient array that is structured and is informative in its own right, then Garner's argument is not an appropriate one. This difference in the definition of 'information' is a major distinction between cognitive and direct perceptual theories. It is interesting to note that in 1974 Garner appeared to have shifted ground to take a more Gibsonian approach to information stating that "stimulus information, or structure, provides meaning and is pertinent to what I would call perception" (p. 2). To overcome Garner's original arguments concerning response uncertainty, future studies may need to sufficiently control information (i.e., to manipulate information independently of responses, such as inclusion of a 'dummy' response choice). While this study did not hold response uncertainty constant and cannot therefore totally overcome Garner's arguments, when viewed from an ecological perspective, the results of this study can, at the very least, suggest that attunement could result in greater specificity and result in more accurate identifications. However, further research is necessary before conclusive arguments can be put forward.

Perceptual Learning

If, as argued by E.J. Gibson (1969), perceptual learning is the increased ability to extract and differentiate progressively finer levels of invariant structure in the real world, and perceptual development is a outcome of both experience with an environment and maturation of the individual in that environment, then one would conclude that the results of this study showed no significant support that perceptual learning took place over repeated exposure to the simulated dyadic events in the forced-choice conditions (FC1 and FC2). Such a finding was contrary to the arguments of E.J. Gibson (1969), McArthur & Baron (1983), and Smith &

Ginsburg (1989).

However, several factors may have effected such a result. Firstly, participants were exposed to events in the free-verbal condition prior to the forced-choice conditions. Perceptual learning may indeed have taken place between these sets of trials, but the experimental design was insensitive to it. Secondly, there was a slight increase in overall accuracy from the first to the second forced-choice conditions which was worthy of note. This increase in accuracy for the second forced-choice condition held across all three events as well. Further trials may have resulted in more frequent identifications by participants, thus lending support for perceptual learning. Thirdly, E.J. Gibson (1969) suggested feedback is an important element in perceptual learning. The total lack of feedback in this study may have also accounted for no apparent perceptual learning across repeated trials. Finally, the proportion of accurate identifications in all of the forced-choice conditions was very high for all events, leaving little room for improvement. This may have been overcome with a larger sample size, more trials, or by using more events with a wider variation in interactivity. Further research that (1) keeps the response conditions constant, (2) allows for more improvement, (3) provides feedback, (4) includes a larger sample size, and (5) provides a wider variety of interactions would be better equipped to assess perceptual learning.

Sex Differences

Results of this study did not support the original hypothesis that there would be differences between the sexes in their ability to accurately identify the nature of the three simulated dyadic social events. However, an observation by the experimenter may be worthy of note. Although all participants had a reasonable amount of time between trials in which to respond, it was observed that females made more rapid identifications than did males. As Bernieri et al. (1994) have suggested, the "combined effect of greater interpersonal orientation and superior nonverbal sensitivity" (p. 308) may make females more sensitive than males to information specifying the "social consequences of interactional synchrony" (p. 308). If females are indeed more open to such consequences, then perhaps they become able to detect the nature of such events, if not more accurately than males, then perhaps more rapidly. Such a system could have evolutionary significance. A study of reaction times between males and females could be of benefit for someone interested examining this issue. For example, is there a difference between sexes in the amount of time required to pick-up information specifying a dangerous or threatening interaction? The addition of a purposeful task, like identifying whether the event was threatening or not, could assist in determining any differences between males and females.

Furthermore, Ginsburg and Smith (1993) have suggested male and female observers may well have different perspectives in viewing some kinds of cross-sex dyadic social events which could produce a variation in the sensitivity to the behaviours being observed. An examination of sex differences in terms of amount or type of information necessary to make accurate identifications of dyadic events could be useful, as well as variations in sensitivity to same-sex and different sex dyadic social events.

Usefulness of point-light displays

Results of this study lent some support for the usefulness of point-light displays in the examination of dyadic social events. Runeson and Frykholm (1981, 1983), and Runeson (1985, 1994) argued that with point-light displays, the phenomenon on the display screen were constrained by an event happening beyond the scope of the screen, and when such occurrences were made available to observers, they were fertile and, at times, complex samples of real-life human kinematics. However, this study suggested that making that information available to perceivers can be troublesome and caution needs to be taken when presenting whole-body kinematics in point-light displays to study social events.

Specificity and whole-body kinematics

While the whole-body point-light displays used in this study appeared to provide a method for providing information specifying the nature of some dyadic events, it did not appear to adequately do so for all events. The differences in accuracy of identification between full-visual and kinematic only viewing conditions for E2 suggested that at least some of the information specifying this event to participants was either not apparent, not attended to, or inadequate in the whole-body point-light displays. Such a finding strengthens the argument of Runeson and Frykholm (1983) and others (Berry, 1990a,b, 1991a,b; Berry & McArthur, 1986; Berry & Zebrowitz-McArthur, 1988; Berry & Finch Wero, 1993) that bodily kinematics may be only some of the information for veridical perception of events. In this study, several participants in the free-verbal/full-visual condition noted that in E2 the actors were "smiling", suggesting they "knew one another" or were "happy to see each other". It appeared that by not including the kinematic facial information in the point-light displays, important information for identifying the nature of the less gesturally animated E2 was not available to participants with a corresponding reduction in accuracy levels. For less gesturally animated events like E2, point-light displays may need to include additional sources of information, such as facial motion and/or increased bodily information.

Certainly facial information has been shown to be informative. Berry and Finch Wero (1993) suggested that there were lawful connections between certain aspects of facial appearance and certain dispositional characteristics, and that "social perceivers are sensitive to these covariations" (p. 499). They showed that people were able to predict with some accuracy a target person's social dominance, interpersonal warmth, and honesty from facial information. Berry (1991a) found that social perceivers could detect some dispositional properties of other people on the basis of relatively little information. Nonverbal expressive behaviours, such as small facial movements and eye contact, constituted but some of the information available to perceivers. Berry suggested that individuals may directly express their dispositional properties through such subtle facial manipulations. This supported Baron (1990) who found that a mother, when interacting with her own child, was clearly picked out as being the real mother even when facial movement was quite minimal. These findings supported Alley (1988) who suggested that from an ecological perspective, facial appearance should influence the "psychosocial responses of others as many physical attributes are specific to or correlated with certain behavioural tendencies or social affordances" (p. 3).

Again, the inclusion of facial information in the full-visual condition of this study provided participants with information not available to those in the kinematic only viewing condition. Free-verbal responses suggested participants used this information in making identifications of E2 in the full-visual viewing condition, thus accounting for at least some of the difference in responses between the full-visual and the kinematic only conditions. A further study, either masking the facial information in the full-visual condition and/or including kinematic facial information in the point-light displays of events, might provide a better understanding of this issue.

Control of information and available metrics

The differences found between the full-visual and kinematic only viewing conditions for E2 also suggested that the reductive nature of the point-light displays in this experiment was irrespective of the informativeness of the kinematics, in other words, there was no control over what information was taken out in the kinematic only viewing condition. Research to date has not been conclusive in specifying which parts or properties of point-light displays are of perceptual importance and which are not. It appeared that point-light displays entail little or no control over the informative kinematics. Berry and Misovich (1994) suggested that when examining social interactivity, one must be careful to control the information in such a manner as to be able to identify what information was necessary to specify the nature of the event. While Runeson (1994) concluded that natural point-light displays do provide a way of ensuring that the information was there, this was either not apparent in this study, or perceivers were not attending to the right kinematic information in the ambient array. One could conclude that to further the usefulness of point-light displays in the study of social events, it is necessary to gain control over the information to be presented and isolate the structural invariants with relational specificity to the corresponding events. There are several ways this can be accomplished.

Newtson (1973) found that differences in the size of an action unit that was discriminated can produce differences in the subjective information state about an observed person. As Newtson (1990) argued, a "sequence of different actions consists of a succession of different dynamical systems. Each action requires reorganisation of the body into a different coordinative structure" (p. 168) with new specificity to actor and observer alike. Newtson, Engquist, and Bois (1977) measured these successive reorganisations by assessing the changes in joint angles using point-lights.

Such a technique of successively reducing (or increasing) information using point-lights could be one way at getting at the critical information for making veridical assessments of dynamic social events. Under such procedures, critical points and significant changes in frequency of identification of such events would more likely be a function of kinematic information (which can be controlled indirectly) than of the number of lights (which can be controlled directly but has an indirect relation with kinematics). A possible solution lies in manipulating the number and order in which lights with different informativeness are added. Another is in the possible configurations. For example, Bingham (1993) found that the placement of the first two point-lights on the head and ankle to specify the vertical extremities of individuals in a lifted-weight experiment provided enough information for participants to make fairly accurate judgements. Earlier, Cutting & Kozlowski (1977) used a technique of varying number and configuration of point-lights to find that specific patterns of kinematic information specified sex and even acquaintanceship between actor and participant. Other appropriate metrics to measure specified amounts of kinematic movement, such as changes in joint angles, gross magnitude of optical activity, and/or total distance of specific movements within displays, would assist in determining if what Ginsburg & Smith (1993) call 'critical actions' exist and where they might exist within the stream of action. Using actors to manipulate information in order to gain control over that information may be an effective tool in the examination of the kinematic specification of social events. By having actors 'over-act' and/or 'under-act' specified social events, isolating particular movements, and using a metric, such as one of those mentioned above, kinematic information could be effectively controlled, manipulated, and measured. Such techniques would have provided a metric for levels of gestural animation (which was absent from this study) making measurement of levels of gestural vigorousness a controllable variable. Application of appropriate metrics would make information a controllable, tractable, measurable variable within the context of an ecological approach. Future studies may need to include such techniques to identify the relational specificities in the dynamic kinematics of social events.

Whole-body and facial information

The use of point-light displays may be a good tool in determining what information perceivers attend to when identifying social events and whether or not attensity (the ecological significance, adaptive value, or probability of being attended to) changes across events and across viewing conditions. For example, a study of eye movement and reaction times in this experiment would have been useful. By measuring where a participant's eyes were focused and where they moved to on the display screen across viewing conditions would allow researchers to examine correlations of movement between full-visual and kinematic only versions of events. Did participants attend to the same information in the same order in each viewing condition? When events were varied, did participant's eyes start by exploring whole-body kinematics then move to facial information to make identifications, or the other way around, or not at all? Were there differences in patterns of eye movement by response condition? Did patterns of eye movement differ in the forced-choice condition when participants were actively searching for invariant structure available in the optical array with specificity to one of only three possible dyadic events compared to patterns of eye movement in the free-verbal condition where they had no information as to what the possibilities might have been? Such a technique applied to this study may have shed further light on the differences for E2 between the full-visual and kinematic only viewing conditions and offered a possible suggestion as to whether or not perception of social events is orderly from one source of structure to another and the possible direction of that order. Did participant's eye movements in the full-visual condition attend to bodily kinematics first then move to explore facial information before making an identification, and did this pattern of information pick-up for E2 vary from that for E1 and E3? And what information did participants in the full-view condition attend to for E1 that resulted in less accurate identifications than E3? Such a technique could have provided possible answers to such questions.

By studying reaction times in conjunction with the addition or reduction of information in the displays, researchers would have another method to assist in determining the level of specificity of the information that was either added or subtracted. When critical information was removed (or reduced) a corresponding reduction in speed of accurate identification should result. The assumption of the researcher in this study regarding the observed differences between males and females in the speed of identifying the dyadic events could also be tested this way.

The study of eye movement and reaction times offers some promise for further research. Application of suitable metrics and proper research design could converge on the critical information available in the ambient array and measure specificity of controlled information available to perceivers viewing social events. With reference to this experiment, such a technique could possibly determine what information participants attended to to make accurate identification of events, and whether or not there was a difference in attensity of particular information and what specificational properties that information had with relation to the event being viewed.

Use of simulations

As previously discussed, the use of simulations can be effective tools in examining dyadic events by providing ways to gain control of the information presented to participants. However, the results of this study showed that researchers do need to be cautious of just what is controlled when simulating dyadic events. In this study, controlling for the 'distance between' actors resulted in a confounding variable being introduced.

It was suggested previously that the simulations for E1 were either (a) not identical for DL and DR, or (b) did not adequately depict the desired dyadic event. As explained in the method section, controls were in place during recording to ensure simulations by direction of entry of the actors were as identical as possible. However, the reported review of E1 by direction of entry showed a difference between the two simulations in the free-verbal condition that may have accounted for the difference in results in this condition. This supports the argument that the two simulations were not identical with a resultant difference in accurate identifications by direction.

There is also evidence to support the second possibility, that the simulations for E1 did not adequately depict the desired dyadic event. Evidence that E1 did not represent the desired dyadic event as well as E2 and E3 represented their respective events became evident when a review of free-verbal responses and an examination of responses considered 'inaccurate' was undertaken. Nine of the forty-eight participants in the free-verbal condition commented on the "distance between" the two actors in E1 as influencing their final response. This was apparent across both viewing conditions. In fact, several participants actually began their free-verbal response by identifying E1 accurately, but then changed their responses commenting on the "distance between" actors as the reason. One participant commented "it looks like a couple who haven't seen one another for a while and are really happy to see each other, but they are standing too far apart. I guess they're just friends getting together.....". Such responses were not evident for the other two dyadic events under investigation.

In each of the instances where participants commented on the 'distance between' the actors, they identified E1 as E2. A further review of incorrect E1 answers in both viewing conditions showed that four out of five incorrect responses for E1 identified it as E2 in both the free-verbal and forced-choice conditions. It appeared that by controlling for the 'distance between' the actors when recording the simulated dyadic events, a confounding variable was unexpectedly introduced. It must be suggested that the 'distance between' the actors was in itself important information that participants can and did attend to, and that this information had specificational properties which confounded the results of this study.

This result pointed out some of the problems in using actors and simulated events for studying social phenomenon. As Berry and Misovich concluded, researchers do not have to refrain from using posed or role-played events, but they do need to be cautious of conclusions drawn from such studies. Indeed, while using actors may not be as ecologically valid as using individuals in real-world interactions (Good, 1986; Berry & Misovich, 1994) there are suggestions as to how such problems can at least be partially overcome. For example, using professional actors in simulations could assist in rendering more precise simulations. Hannah, Domino, Hanson, and Hannah (1994) suggested that experienced, professional actors take on at least some of the personality dimensions of the character they were to play, and Berry and Misovich (1994) agreed that there are individual differences in the ability to successfully manipulate or fake social events. Experienced actors or even some sales people, for example, are extremely adept at such practices and would be better than novice actors in replicating the desired nature of a social event. Using experienced actors in simulations may prove beneficial for future studies. However, the greatest potential to overcome the use of simulations appears to reside with new computer technology.

New technology

New computer technology may give point-light displays added usefulness in the examination of social phenomenon. It is now possible to record real-life social events and, using computer technology, attach point-lights to the individuals involved. In this fashion, the amount and location of kinematic information could be manipulated and measured, metrics applied to movement in the optical array, and variables, such as direction of entry which caused problems in this experiment, could be controlled by computer aided 'flipping' of the picture so the identical event was viewed from both directions. Using this kind of technology would also overcome the problems experienced in this study regarding the accurate representation of events using simulations and the introduction of confounding variables such as the 'distance between' actors. Computerised placement of point-lights on events filmed in the real world would more closely examine what Warren and Shaw (1985) suggested the appropriate unit of analysis for ecological psychology should be, "an ecological event " (p. 10), and reduce criticism of the use of staged or role-played events. This entire area of research is yet to be fully examined and appears to hold some promise for the usefulness of point-light displays as effective research methods.

Predicting social behaviour

Finally, point-light techniques may be useful in examining the prediction of social behaviour. Based on the arguments of Reed (1982), Runeson (1985) stated that "the occurrence of pre-adjustment of posture is a universal feature of our action system" (p. 59). In other words, co-ordinative structures may be set up more or less in advance of action and therefore may prevail in the system for extended periods, even when the person is not moving at all. According to Runeson, the "system does not have to wait for sensory feedback concerning the relative effects before it can compensate. Active and reactive effects are lawfully related through mechanics and the action system is organised to take advantage of this" (p. 59). This point is extremely relevant to nonverbal research in that the kinematics may specify the intentions, expectations, and/or emotions of the individuals involved in dyadic social events, and perceivers may obtain this information directly and accurately without having to evoke schemas, scripts and/or categorisations, and such information may be available even when the actual behaviour has yet to take place. Therefore, showing participants varying portions of a social event and asking them to predict the nature of the event to follow could be a way of controlling information, measuring the critical actions setting up behaviour, and finding possible support for Runeson's argument. This could be accomplished either through using simulated events or by recording real-life social events and attaching point-lights. In this way, usefulness of kinematic information in predicting social behaviour could be examined, as well as isolating what information has specificity to the prediction of social behaviour. This same technique could be utilised to examine dispositions, traits, emotions, and other previously phenomenon previously considered intrinsic or hidden.

Summary

This preliminary study attempted to examine from an ecological perspective the ability of perceivers to identify the nature of simulated dyadic events from point-light displays. Results at least partially supported the arguments of Runeson and Frykholm (1983), Runeson (1994), and Good (1986, 1987) that perceivers could identify social events when presented with kinematic information only. However, several issues became apparent as a result of this study.

Firstly, control over information is vital. While this study showed that participants could identify two out of the three dyadic events equally well from kinematic only and full-visual displays, there was a significant difference for one of the events. Unfortunately, as there was no control over information in this study, it was not possible to determine what information was either missing, not attended to, or inadequate in the kinematic version of events that was available to and used by participants in the full-visual condition to make more accurate identifications. It appeared that the reductive nature of point-light displays was irrespective of specificity and the informativeness of information can only be determined if it is adequately controlled.

Secondly, suitable metrics for amount and type of information must be employed. Gross optical movement, gross changes in joint angles, and/or amount, number, location, or configuration of point-lights are but some of the possibilities. Such metrics need to have specificity to the variable(s) under examination and the information measured needs to be carefully controlled. A measure such as gross optical movement could have been employed in this study to identify and measure differences in gestural animation and allowed for more conclusive arguments regarding gestural vigorousness. Other types of measures, such as tracking of eye movement and reaction times could also be employed.

Thirdly, while acceptable, caution needs to be employed when using actors to simulate real-life social events. In this study a confounding variable was inadvertently introduced by placing constraints on the actors (i.e., controlling for the 'distance between'). Researchers need to take particular care when replicating natural events and to ensure what they are controlling is measurable and part of the experimental design. Use of professional actors could provide ways of controlling information, such as in 'over' or 'under' acting to isolate particular movements and their specificity to events. While previous findings suggest perceivers are good at picking up information specifying deceptive intent, there are still bonuses in using such techniques provided researchers are cautious in reporting their findings.

Despite the constraints mentioned above, this study did show that participants could identify the nature of some dyadic events when viewing kinematic information only, and that at least for two of the three events they could do so at levels equal to those of participants exposed to a full-visual version of events. It appeared that information specifying the nature of these two dyadic events was available, attended to, and adequate enough for participants in the kinematic only condition to make accurate identifications of the corresponding dyadic events.

Furthermore, this study supported Runeson and Frykholm's (1983) argument that point-light displays are more effective when vigorous gestural animation is apparent, suggesting the use of whole-body kinematics may need to be restricted to events with relatively high levels of gestural vigorousness. However, it was not apparent whether this is really a requirement, or if adding other information (such as facial information) to point-light displays would result in an increase in accurate identification of events, particularly those low in gestural animation. Further research is required in this area.

The prediction that by providing participants with a forced-choice task would result in an increase in identification of events, while supported in this study, did not necessarily allow for the argument that such increases were due to attunement of the perceptual system. However, several research possibilities were put forward that could assist in overcoming the arguments of Garner and others regarding response uncertainty.

While results of this study did not support the perceptual differentiation theory of E.J. Gibson (1969), nor the prediction that differences would exist between the sexes, suggestions were made to assist future researchers in adequately addressing each of these issues.

Indeed, this study offered numerous suggestions as to avenues for further research using point-light techniques. Such areas as the study of dispositions, emotions, intentions, and the prediction of social behaviour were covered and possible research techniques suggested. It appeared that the use of point-light techniques offered unique potential in the further examination of social phenomenon from an ecological perspective provided researchers are vigilant to ensure information is controlled, suitable metrics are employed, and the constraints of using simulations are overcome.

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APPENDIX

APPENDIX A

University of Canterbury
Department of Psychology

INFORMATION

You are invited to participate as a participant in the research project:

"The kinematic specification of dynamic social interaction using point-light displays."

The aim of this project is to see if people can accurately judge the nature of a social interactions based upon the body movements of the couple involved in the event.
Your involvement in this project will take approximately 10 minutes and involve you in watching several video clips and firstly verbally reporting on what you see happening, and secondly, answering a questionnaire as to what you think is happening in each video.
Once you have completed this experimental session there will be no requests made of you for further involvement in this project.
In the performance of the tasks and application procedures there are no foreseen risks to you of any kind.
The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public without there consent. To ensure anonymity and confidentiality, only numbers will be used on the data sheets and these numbers will in no way be correlated to names on consent forms. This way there will be no way to trace any particular answer sheets to any particular person involved in the project.

The project is being carried out by Morry Shanahan, who can be contacted at 364-9072. He will be pleased to discuss any concerns you may have about participation in the project.

The project has been reviewed and approved by the University of Canterbury Human Ethics Committee and the Christchurch Polytechnic Research Committee.

APPENDIX B

CONSENT FORM

"The kinematic specification of dynamic social interaction using point-light displays."

I have read and understood the description of the above-named project. On this basis I agree to participate as a participant in the project, and I consent to publication of the results of the project with the understanding that anonymity will be preserved. I understand also that I may at any time withdraw from the project prior to conclusion of the session, including withdrawal of any information I have provided.

Signed............................. Date..................

APPENDIX C

DATE: __/ __/ __ TAPE NO.____ SEX____ ORDER NO.____

Please mark the answer you think is most correct:

This event shows;

1. _ good friends meeting after not seeing one another for a while,
_ good friends meeting as they do most days,
_ good friends meeting after having had a disagreement."

2. _ good friends meeting after not seeing one another for a while,
_ good friends meeting as they do most days,
_ good friends meeting after having had a disagreement."

3. _ good friends meeting after not seeing one another for a while,
_ good friends meeting as they do most days,
_ good friends meeting after having had a disagreement."

4. _ good friends meeting after not seeing one another for a while,
_ good friends meeting as they do most days,
_ good friends meeting after having had a disagreement."

5. _ good friends meeting after not seeing one another for a while,
_ good friends meeting as they do most days,
_ good friends meeting after having had a disagreement."

6. _ good friends meeting after not seeing one another for a while,
_ good friends meeting as they do most days,
_ good friends meeting after having had a disagreement."

..... etc.

11. _ good friends meeting after not seeing one another for a while,
_ good friends meeting as they do most days,
_ good friends meeting after having had a disagreement."

12. _ good friends meeting after not seeing one another for a while,
_ good friends meeting as they do most days,
_ good friends meeting after having had a disagreement."

APPENDIX D

Instructions to Coders

You are about to listen to responses given by subjects in an experimental environment. Please listen carefully to each respondent and tick the box you consider most closely resembles their verbal response. Responses do not need to be identical to those on your marking sheet, but must resemble the choice more closely than the other options.

Prior to commencement of each recorded response, please enter the subject identification number in the appropriate space on the marking sheet.

Should you want to listen to any of the responses more than once, please let the experimenter know immediately and the verbal response will be replayed again.

Please do not discuss your selections with anyone and the experimenter will answer any questions you may have regarding the nature of the experiment after all coding has been completed.